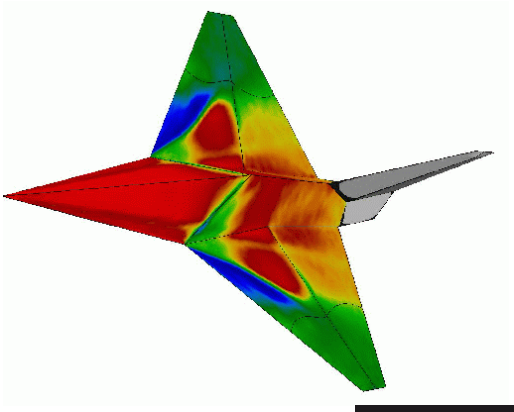
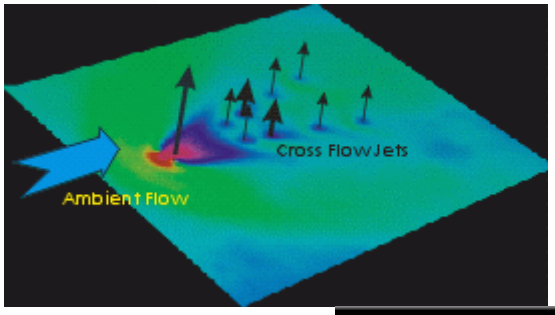
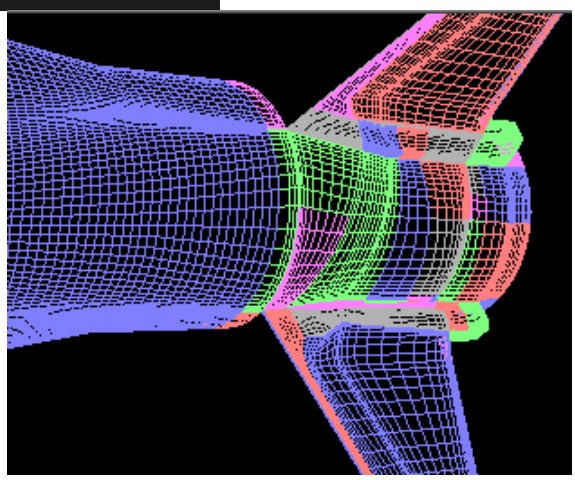
Application Package OMS







U S E R ' s G U I D E S

ProImage

Version 3.1

2006

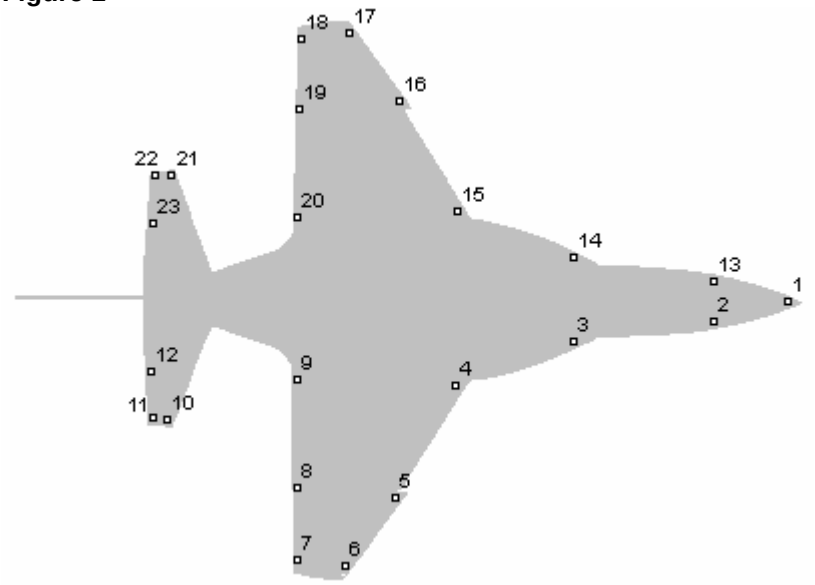
Contents

Preliminary Operations

Step 0. Preparing a Model for Data Processing Using the OMS "ProImage" Program

1. Apply contrast marker points on the model surface. The number and position of these markers should describe the peculiarities of the Model Geometry. The total number of markers should be about 15..25, and applying them on the periphery and extreme points of the model is most effective.

Figure 1



2. Measure the 3D coordinates of these markers, and write them into a file (in our case, MARK_UP.APM).

   Note. The file is a list of marker coordinates in ASCII format.

3. Prepare a bitmap with the model image.

4. After starting *ProImage* open an existing bitmap SENS_OFF.B16 that is located in subfolder SAMPLES\STEP_0 of the current folder:

   Choose the **Open...** command from the **File** menu,

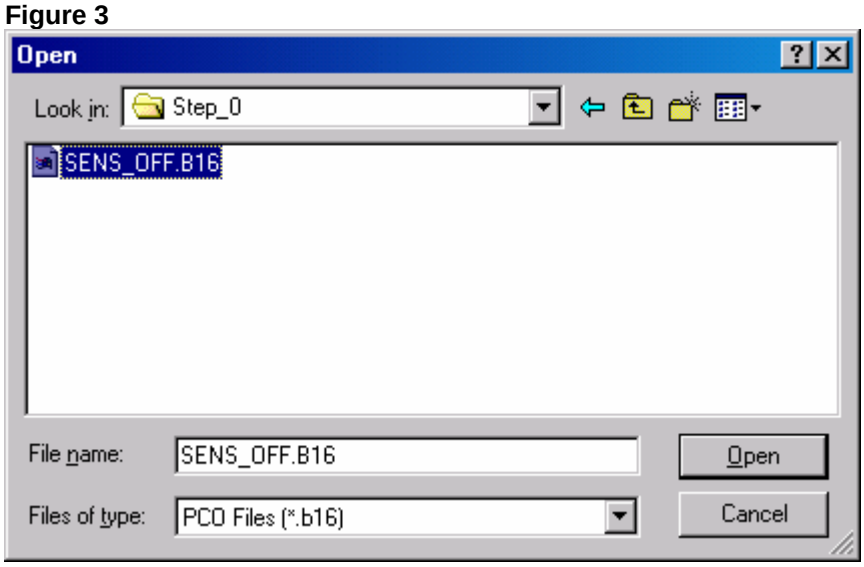
   or

   Click the following icon from the upper toolbar:

Figure 2

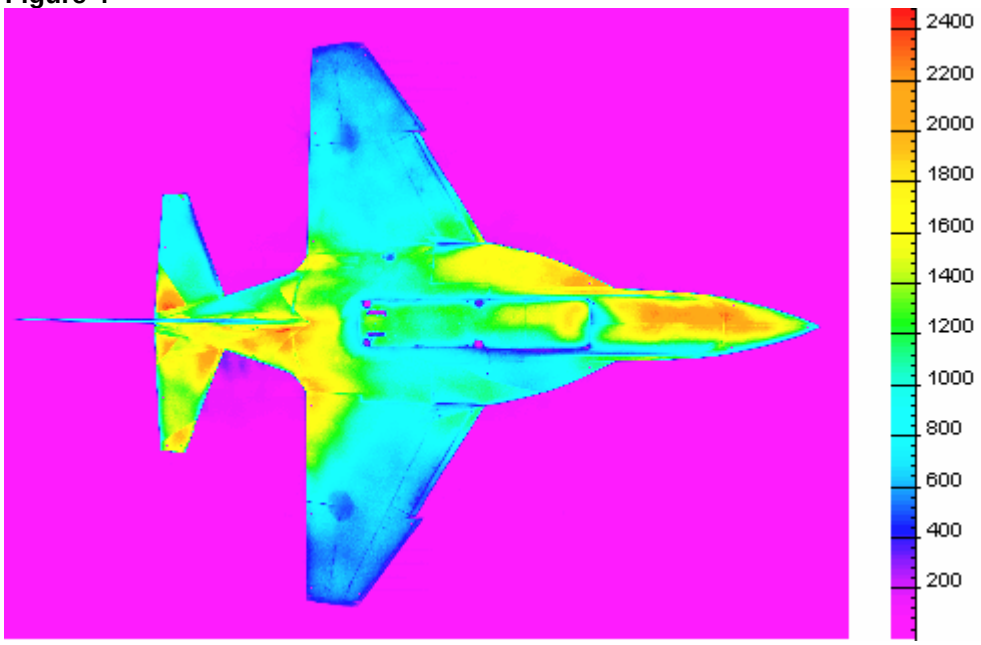
The standard ***Open Dialog*** will appear on your screen.

Figure 3



5. Choose the file STEP_0.B16, and click the **Open** control button. The ***Open Dialog*** will be closed, and the bitmap will appear on your screen.

Figure 4



6. Select 2D markers on the bitmap in the order of sequence of the 3D marker numbers using the model photo (**Figure 1**).

   Choose the **Mark...** command from the **Markers** menu,

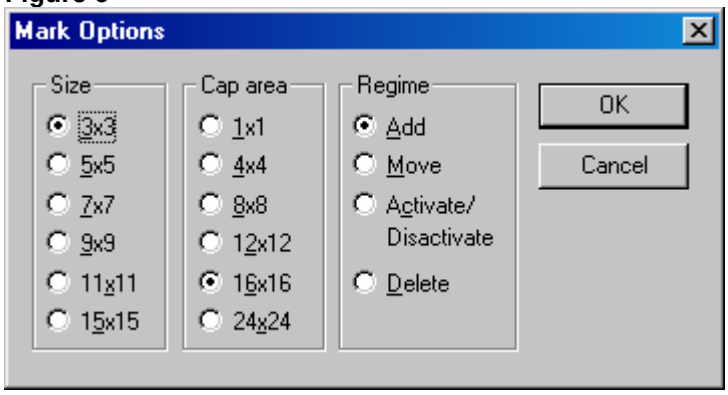
   or

   Click the following icon from the upper toolbar:

Figure 5

The ***Mark Options Dialog*** will appear on your screen.

Figure 6

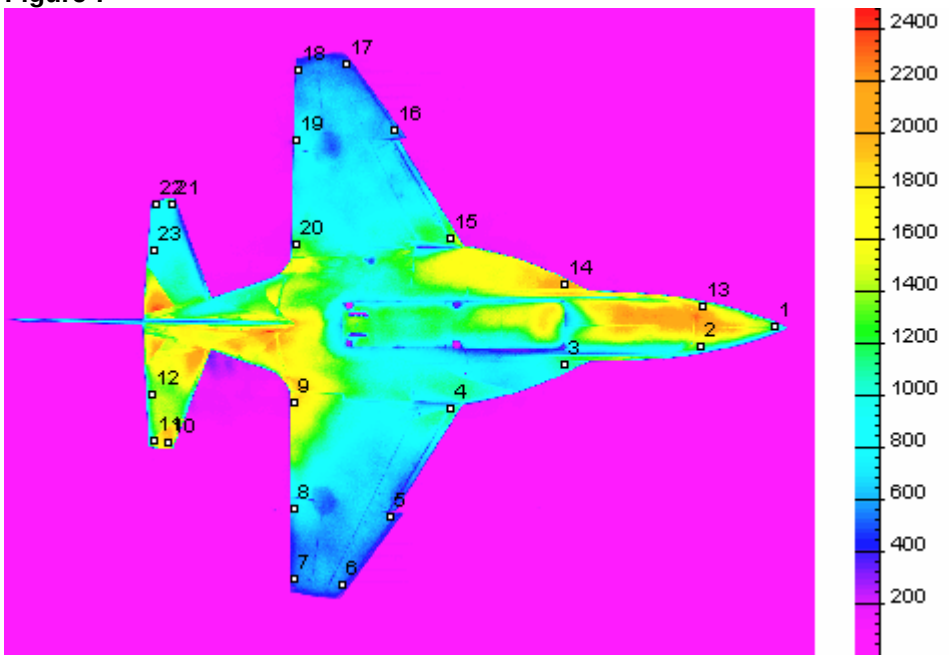


7. Choose all of the needed parameters in the ***Mark Options Dialog*** as shown above.

8. Click the **OK** control button. The cursor shape is changed to  . Click on the points on the bitmap, and the markers will be placed at these points.

   Note. The selection of markers is to be performed with the highest accuracy. If a marker has been selected inaccurately, it is recommended that this be corrected through the use of **Move** radio button. Use of the **Delete** radio button does not change the numbers of the rest of the markers. If a marker is to be added (using **Add** radio button), it will acquire a number that is equal to the last marker number plus one. Therefore, the order of the marker numeration may be violated.

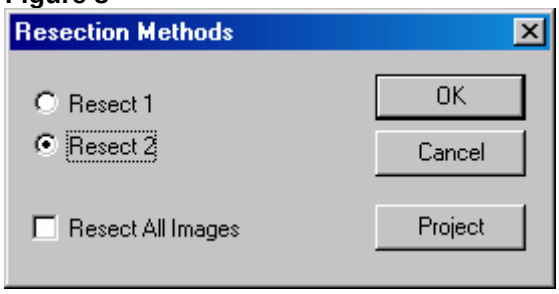
Figure 7



9. To turn off the regime of marker selection, choose the **Mark...** command from the **Markers** menu again.

10. The quality of the marker choice can be controlled using the resection procedure. Choose the **Resection...** command from the **OMS Project** menu. The ***Resection Methods Dialog*** will appear on your screen.

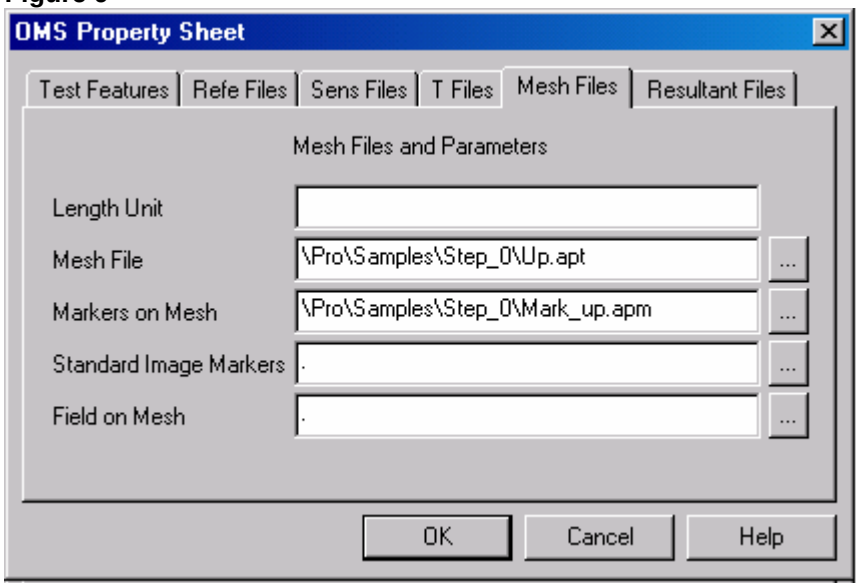
Figure 8



11. Choose all of the needed parameters in the ***Resection Methods Dialog*** as shown above.

12. Click the **Project** control button. The **Mesh Files** tab of the ***OMS Property Sheet Dialog*** will appear on your screen.

Figure 9



13. Choose all of the needed parameters in the **Mesh Files** tab as shown above. The appropriate files are to be chosen from the same folder (subfolder SAMPLES\STEP_0 of the current folder). You may type the names or click the … control button. In this case the standard ***Open Dialog*** will appear on your screen to permit you to choose the files and their storage.

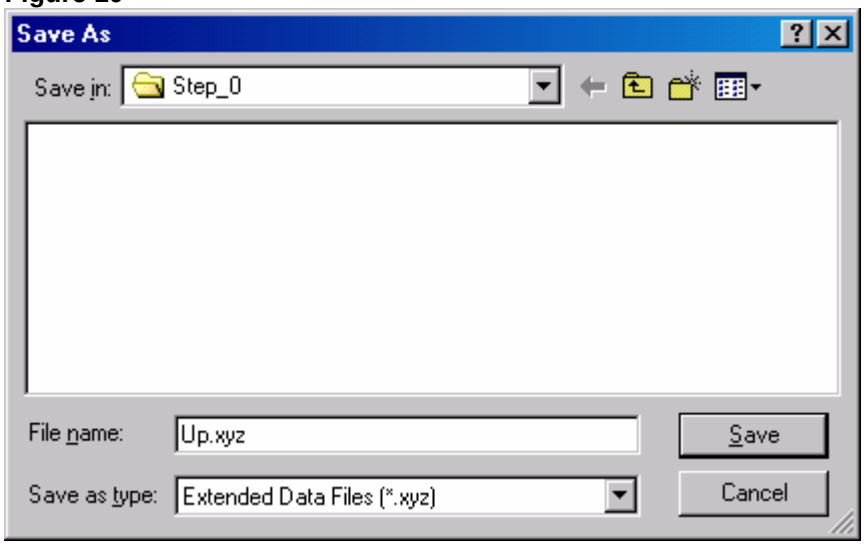
14. Click the **OK** control button. The ***Resection Methods Dialog*** will appear on your screen again.

15. Click the **OK** control button. The warning message concerning the absence of the file with the standard markers will appear on the screen.

16. Click the **OK** control button. The warning messages concerning the transformation error will appear on the screen.

17. Click the **OK** control button or press Enter. The standard ***Save As Dialog*** will appear on your screen.

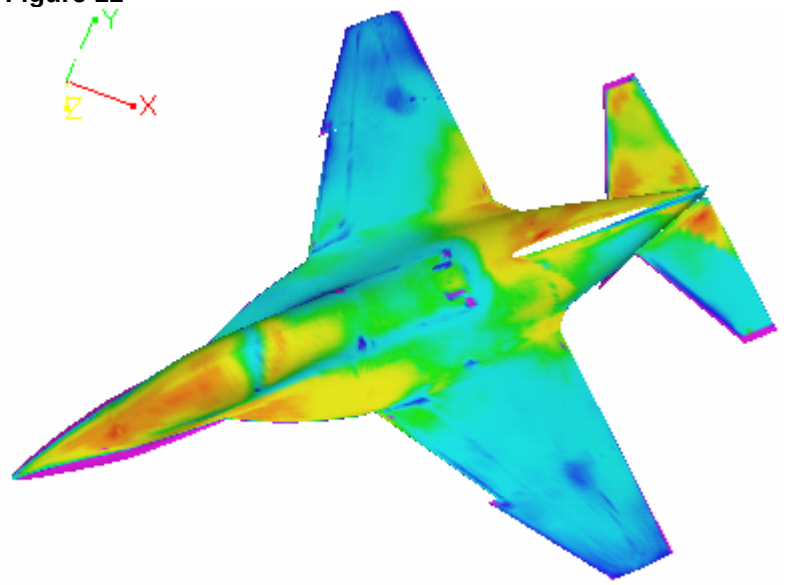
Figure 10



18. Click the **OK** control button. The 3D Flowfield will be saved on the disk with the default name UP.XYZ in the same folder. To visualize it is necessary to open this file using the *ProField* application.

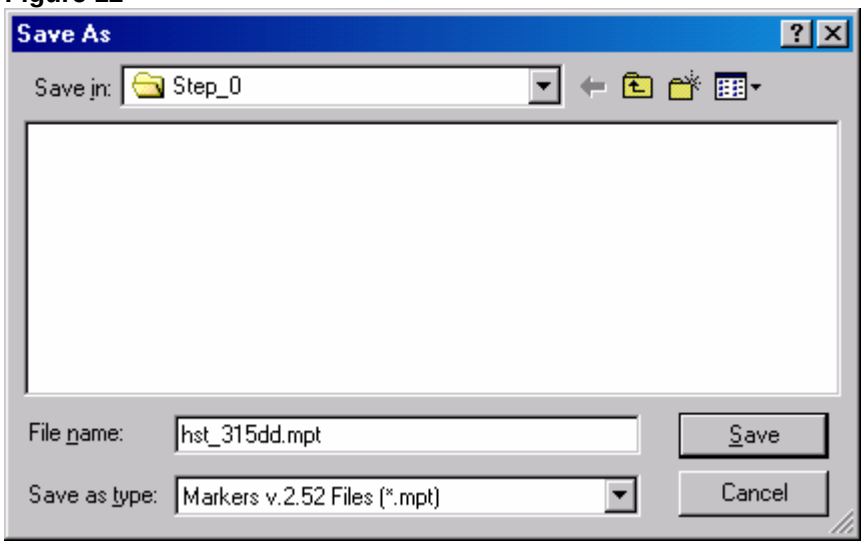
    Note. If the result of the procedure is unsatisfactory (the Flowfield is displaced relative to the Geometry), it is necessary to repeat Steps 6-18.

Figure 11



19. To save the chosen markers on the disk, choose the **Save Markers As...** command from the **Markers** menu. The standard ***Save As Dialog*** will appear on your screen.

Figure 12



20. Choose all of the needed parameters in the ***Save As Dialog*** as shown above.

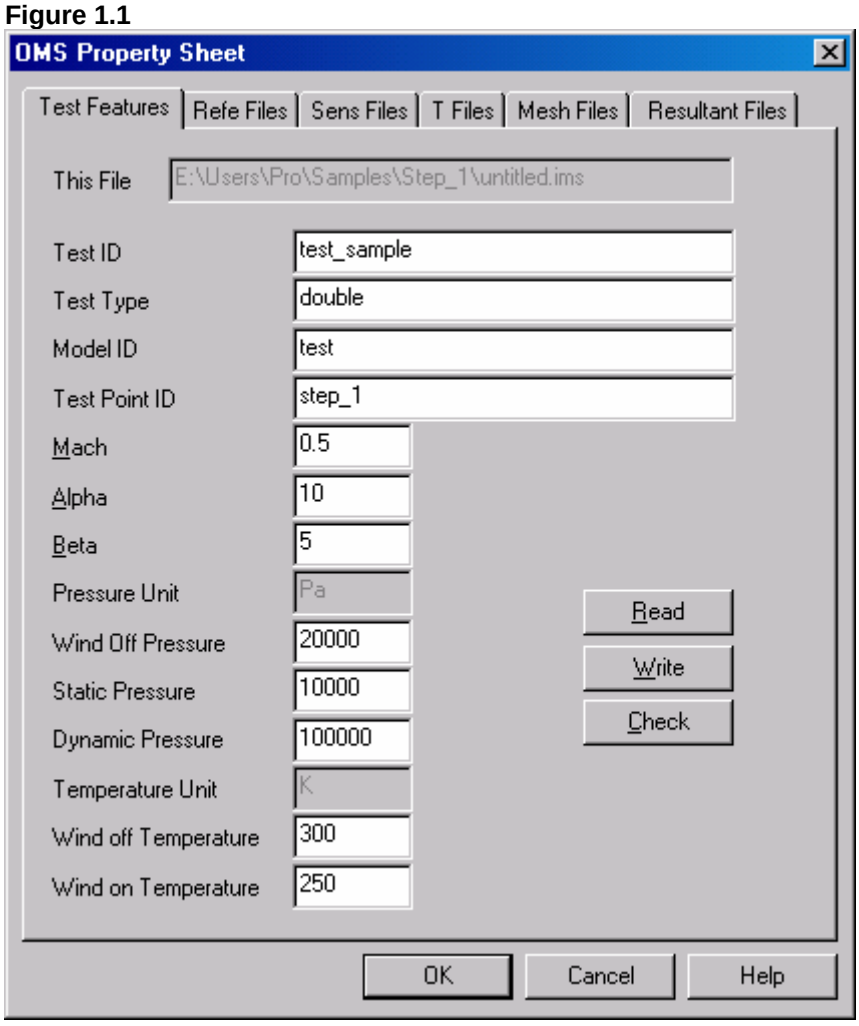
21. Click the **OK** control button. The markers will be saved on the disk as the file HST_315DD.MPT. In subsequent processing this file will be used as a file with standard markers.

Chapter 1. Working with a Project File

Step 1. Creating a Project File

1. To create a new project file, choose the **New OMS Project...** command from the **OMS Project** menu. The ***OMS Property Sheet Dialog*** will appear on your screen.

Figure 1.1



2. Choose all of the needed parameters in the ***Test Features*** tab as shown above.

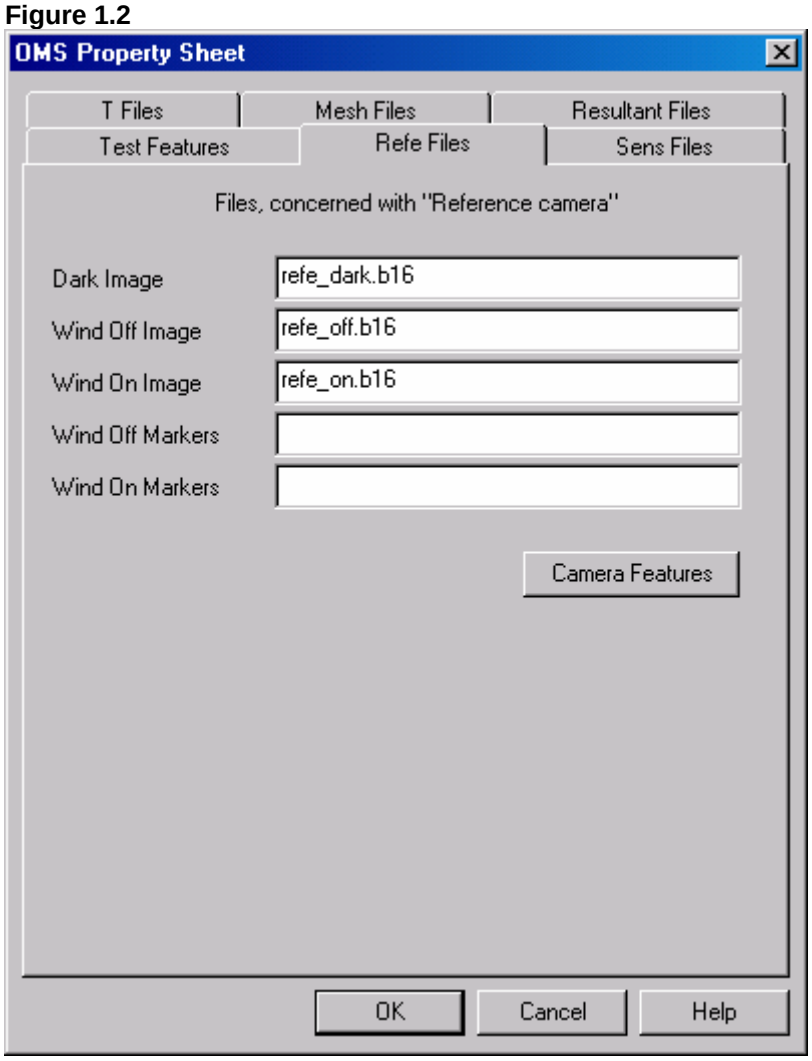
3. Click the **Write...** control button. The standard ***Save As Dialog*** will appear on your screen.

4. Enter subfolder SAMPLES\STEP_1 of the current folder.

5. Type “STEP_1” in the **File name** text box, and click the **Save** control button. The ***Save As Dialog*** will be closed, and the project file with the name STEP_1.IMS will be created. Its name will appear in the **This File** information pane.

6. Click the **Refe Files** tab in the ***OMS Property Sheet Dialog***. It will appear on your screen.

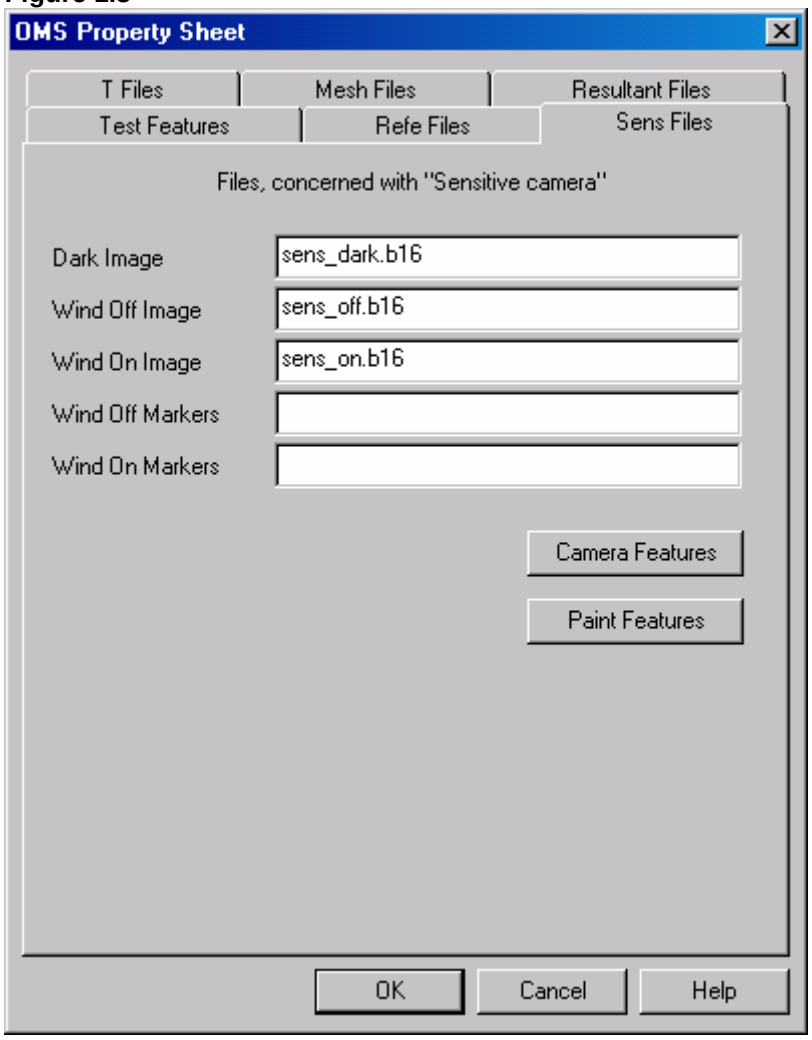
Figure 1.2



7. Choose all of the needed parameters in the **Refe Files** tab as shown above.

8. Click the **Sens Files** tab in the ***OMS Property Sheet Dialog***. It will appear on your screen.

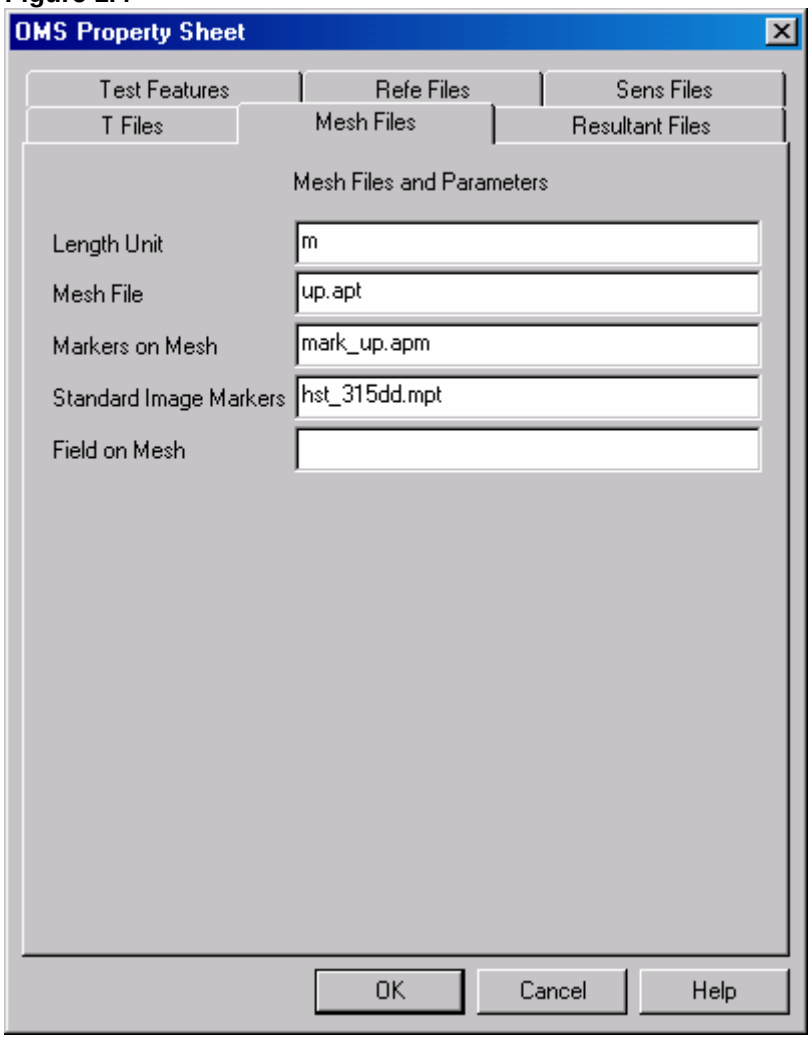
Figure 1.3



9. Choose all of the needed parameters in the **Sens Files** tab as shown above.

10. Click the **Mesh Files** tab in the ***OMS Property Sheet Dialog***. It will appear on your screen.

Figure 1.4



11. Choose all of the needed parameters in the **Mesh Files** tab as shown above.

12. Click the **Test Features** tab in the ***OMS Property Sheet Dialog***. It will appear on your screen again.

13. Click the **Check** control button. The presence of all chosen files in the project folder SAMPLES\STEP_1 will be verified.

14. Click the **OK** control button. The project file will be created, and all chosen parameters will be saved into it.

Chapter 2. Processing a Project

Files Necessary for Working with a Project

Subfolder SAMPLES\STEP_2 of the current folder contains the following bitmaps:

1) REFE_DARK.B16 – a dark reference bitmap;
2) SENS_DARK.B16 – a dark sensitive bitmap;
3) REFE_OFF.B16 – a wind-off reference bitmap;
4) SENS_OFF.B16 – a wind-off sensitive bitmap;
5) REFE_ON.B16 – a wind-on reference bitmap;
6) SENS_ON.B16 – a wind-on sensitive bitmap.

The following files with information concerning markers should be in the same subfolder:

1) HST_315DD.MPT – markers on the image. This file is created manually by the user. It will be used for 3D transformations;
2) MARK_UP.APM – real 3D coordinates of markers on the model.

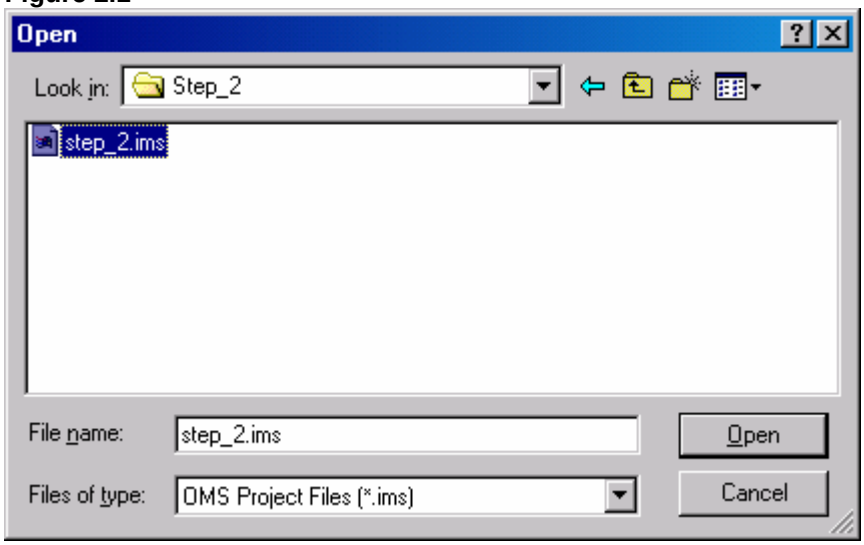
The following files with additional information should be in the same subfolder:

1) STEP_2.IMS – project file that contains the information that is necessary for processing the PSP test data;
2) UP.APT – Geometry of the model;
3) COEFFNEW.CLB – file that contains the coefficients of the calibration;
4) PCO_CAMERA.CAM – file that contains the camera parameters.

Step 2. Processing a Project Using Default Parameters

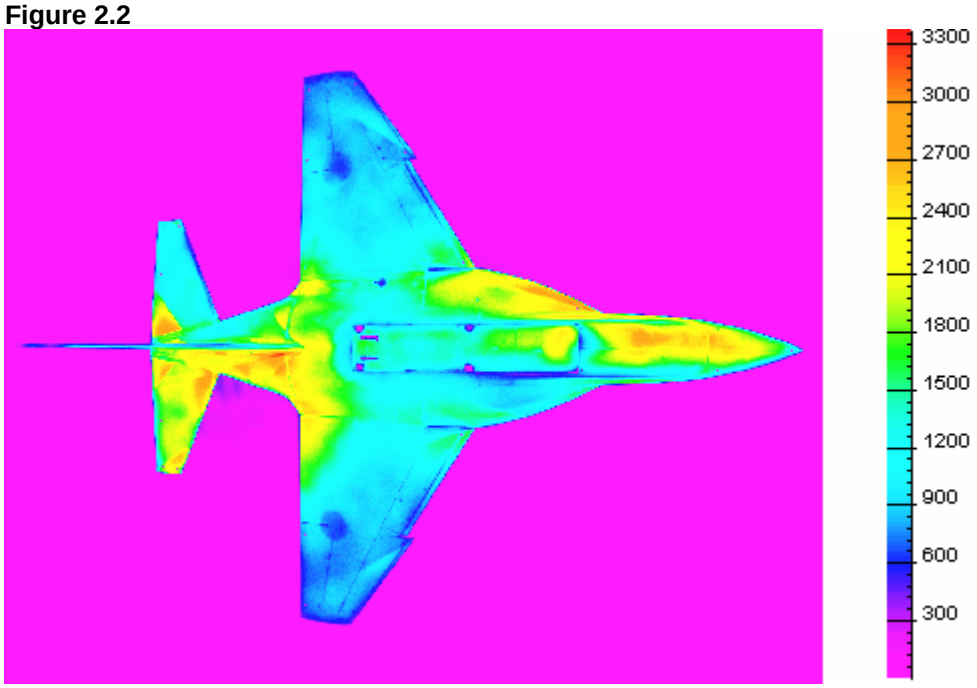
1. After running *ProImage* open an existing file STEP_2.IMS that is located in subfolder SAMPLES\STEP_2 of the current folder. Choose the **Open Project...** command from the **B Convert** menu. The standard ***Open Dialog*** will appear on your screen.

Figure 2.1



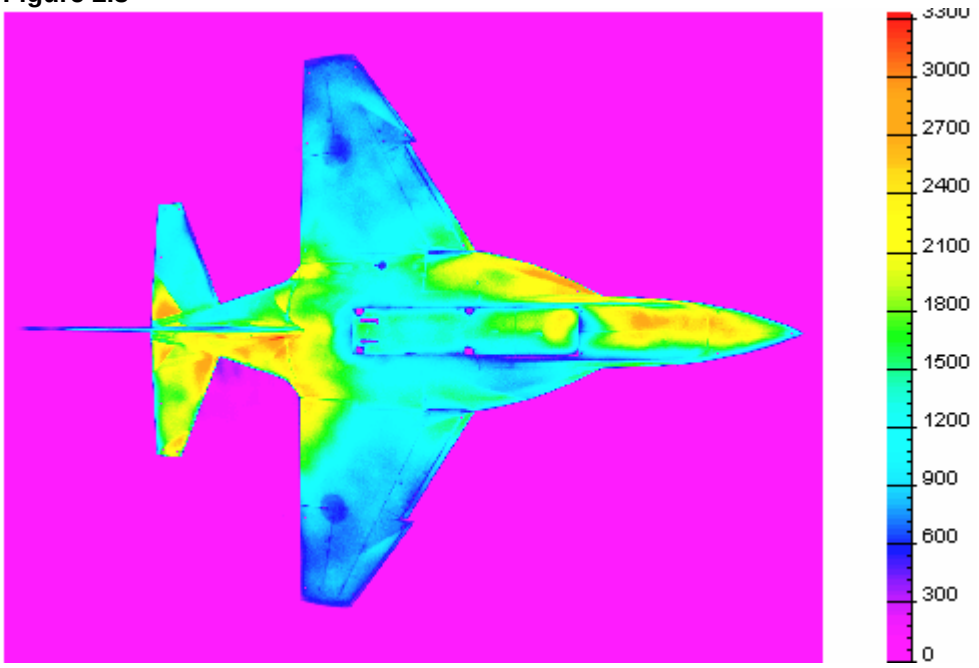
2. Choose the file STEP_2.IMS, and click the **Open** control button. The ***Open Dialog*** will be closed, and the wind-on sensitive bitmap will appear on your screen.

Figure 2.2



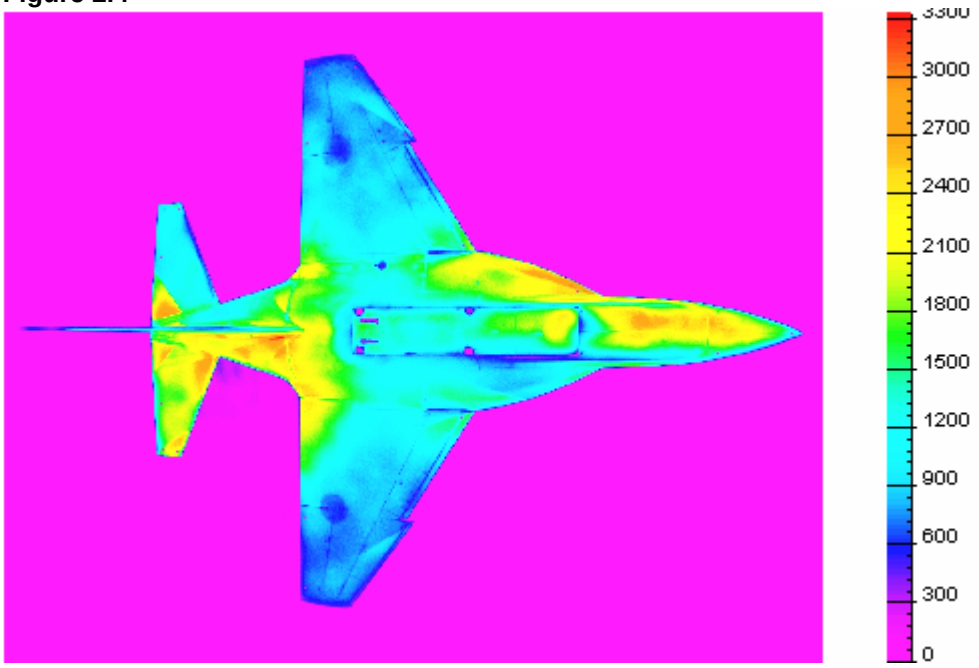
3. Choose the **Dark Frame Subtraction** command from the **B Convert** menu to subtract dark bitmaps from the processed bitmaps. The corrected wind-on sensitive bitmap will appear on your screen. (Four bitmaps--wind-off reference, wind-on reference, wind-off sensitive, and wind-on sensitive--will be corrected. Use the **Image** command from the **View** menu to switch between these bitmaps.)

Figure 2.3



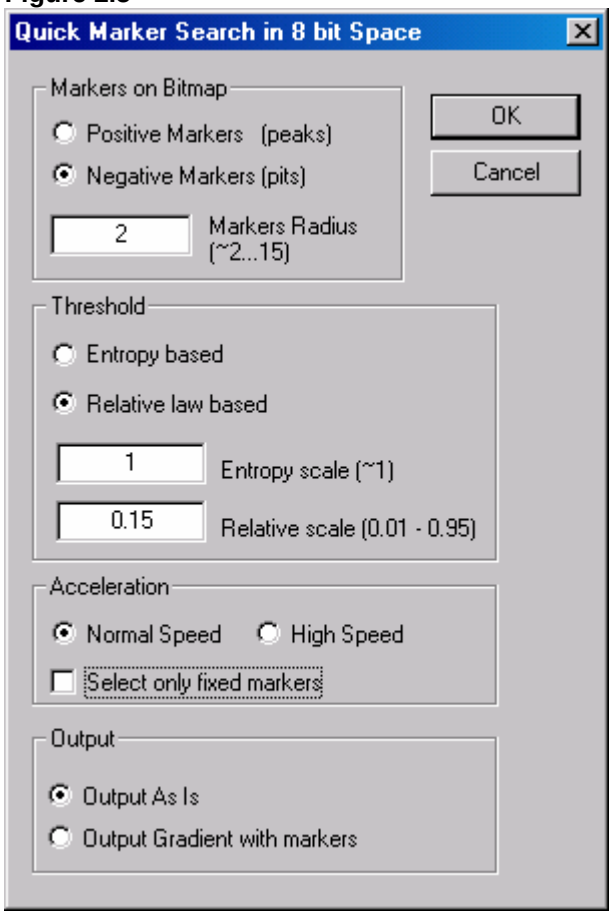
4. Choose the **Flat Field Correction** command from the **B Convert** menu to compensate for vignette-effect of the videocamera objective lens and the spread of the sensitivity of the photodetector array. The corrected wind-on sensitive bitmap will appear on your screen. (Four bitmaps--–wind-off reference, wind-on reference, wind-off sensitive, and wind-on sensitive--will be corrected. Use the **Image** command from the **View** menu to switch between these bitmaps.)

Figure 2.4



5. Choose the **Automatic Marking...** command from the **B Convert** menu. The ***Quick Marker Search Dialog*** will appear on your screen.

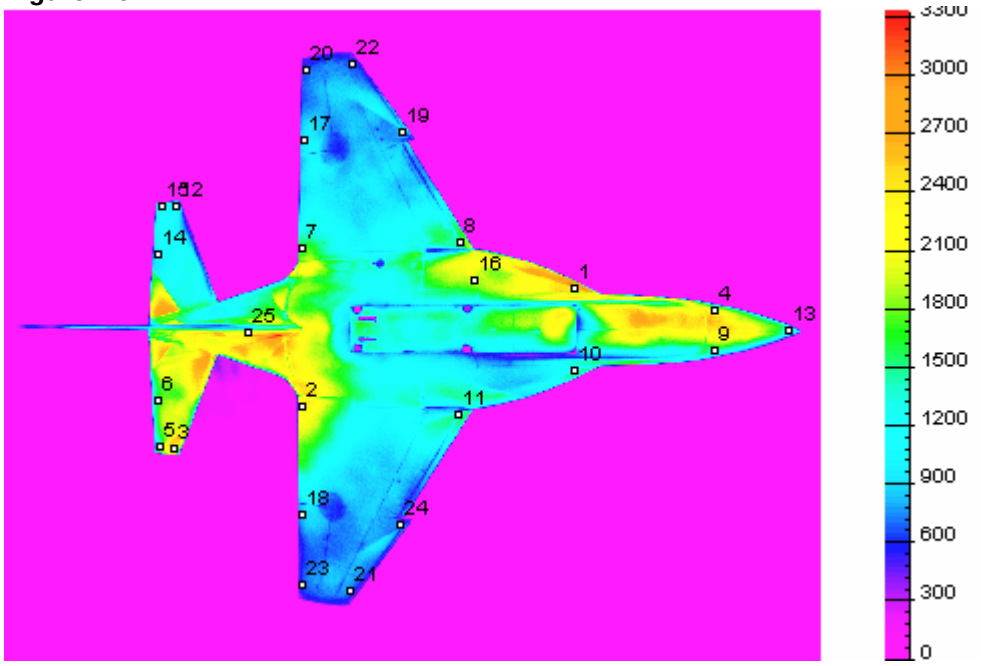
Figure 2.5



6. Choose all of the needed parameters in the ***Quick Marker Search Dialog*** as shown above.

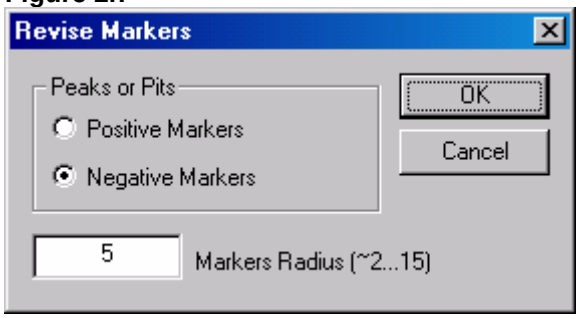
7. Click the **OK** control button. Four bitmaps with markers will be created (wind-off reference, wind-on reference, wind-off sensitive, and wind-on sensitive). Use the **Image** command from the **View** menu to switch between these bitmaps.

Figure 2.6



8. Choose the **Markers Precise Position...** command from the **B Convert** menu. The ***Revise Markers Dialog*** will appear on your screen.

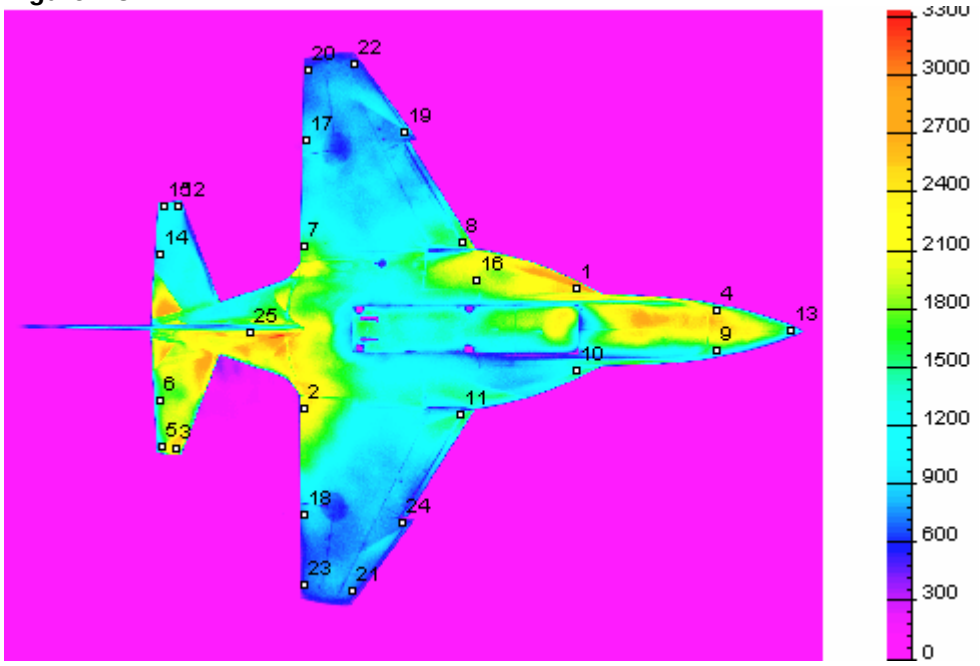
Figure 2.7



9. Choose all of the needed parameters in the ***Revise Markers Dialog*** as shown above.

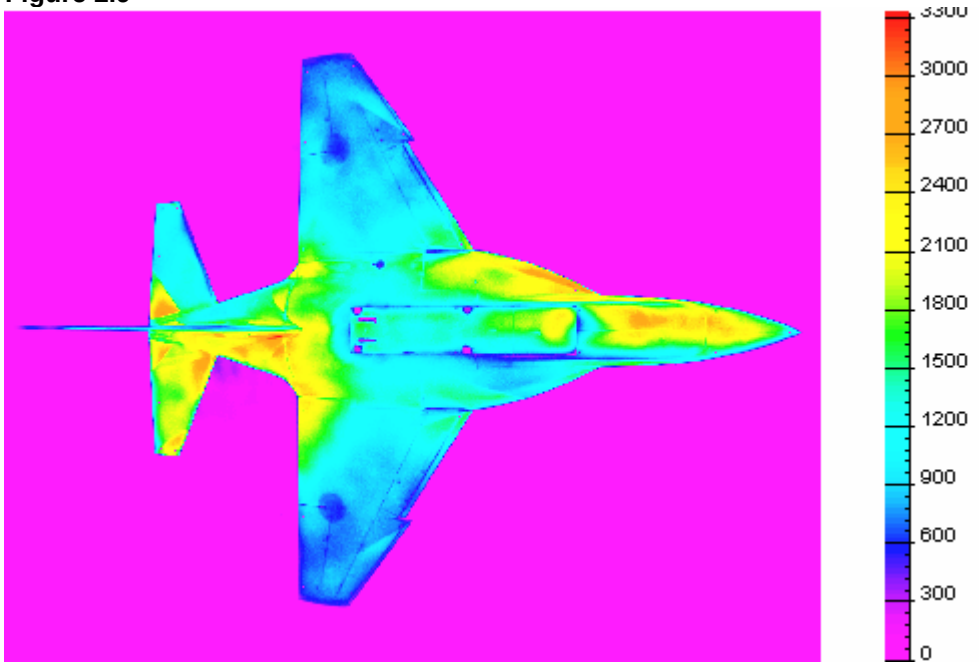
10. Click the **OK** control button. The position of the markers will be corrected.

Figure 2.8



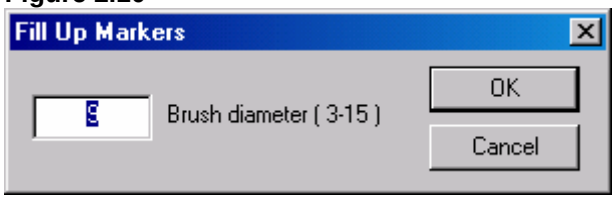
11. Choose the **Hide Markers** command from the **Markers** menu. The special symbols of the markers and their numbers will become invisible.

Figure 2.9



12. Choose the **Fill Up All Markers...** command from the **B Convert** menu to remove the marker images from the bitmaps. The ***Fill Up Markers Dialog*** will appear on your screen.

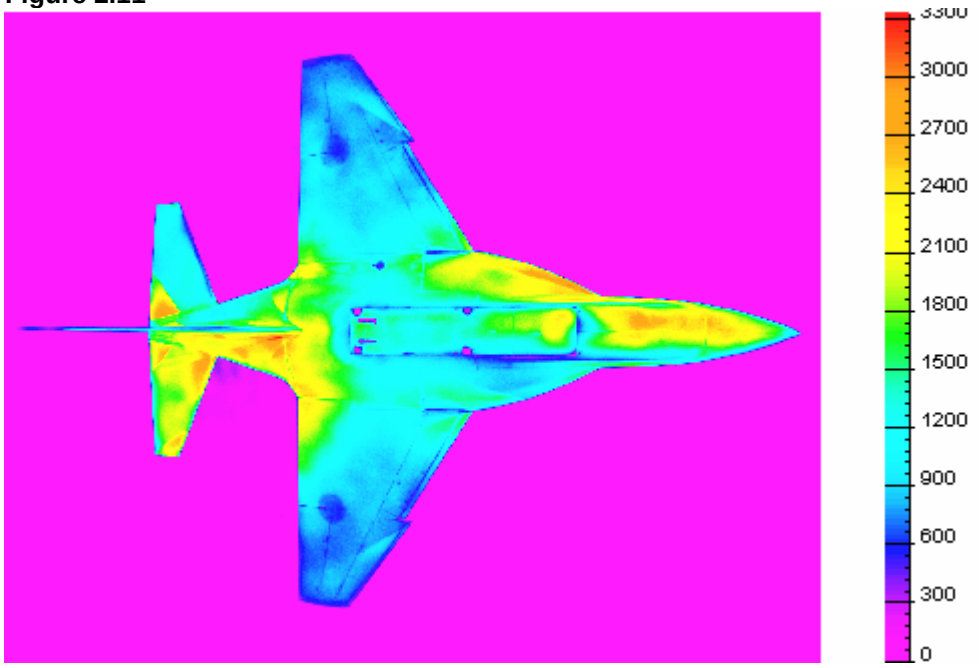
Figure 2.10



13. Choose all of the needed parameters in the ***Fill Up Markers Dialog*** as shown above.

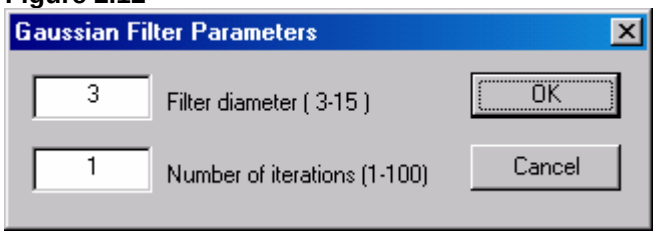
14. Click the **OK** control button. The position of the markers will be corrected.

Figure 2.11



15. Choose the **Filtering...** command from the **B Convert** menu to apply the 2D Gauss filter on the bitmaps. The ***Gaussian Filter Parameters Dialog*** will appear on your screen.

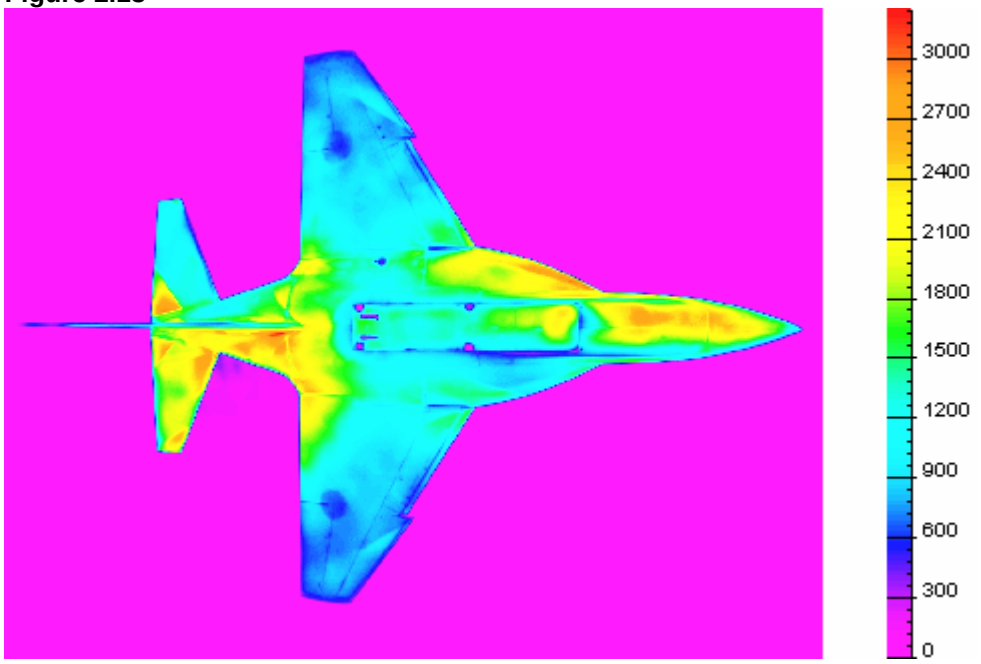
Figure 2.12



16. Choose all of the needed parameters in the ***Gaussian Filter Parameters Dialog*** as shown above.

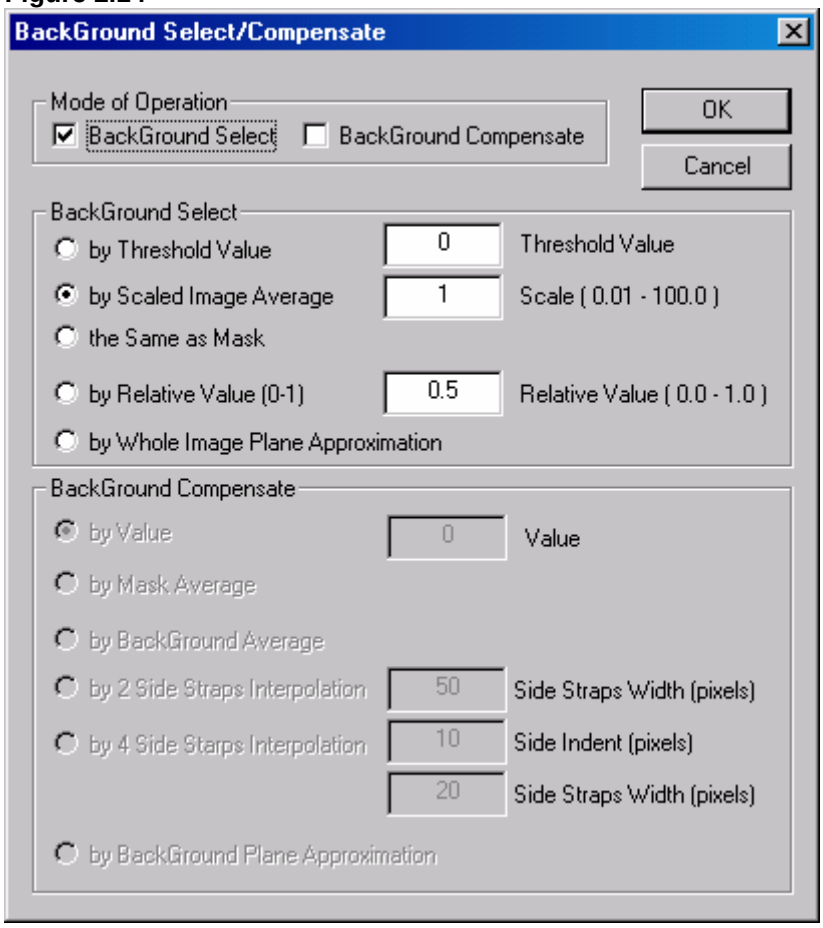
17. Click the **OK** control button.

Figure 2.13



18. Choose the **BackGround Work...** command from the **B Convert** menu to remove the background on the bitmaps. The ***BackGround Select/Compensate Dialog*** will appear on your screen.

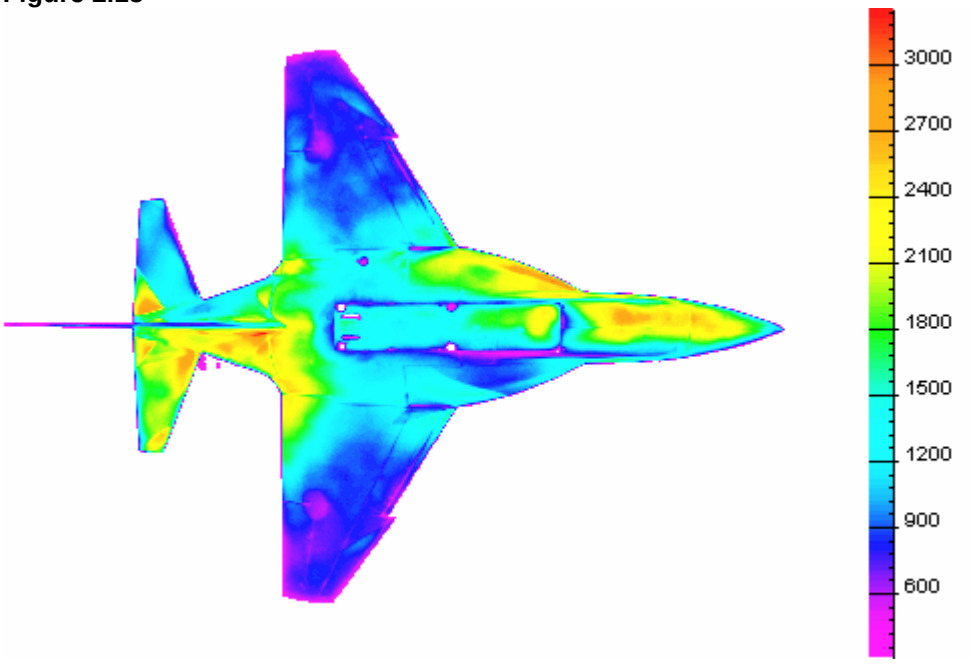
Figure 2.14



19. Choose all of the needed parameters in the ***BackGround Select/Compensate Dialog*** as shown above.

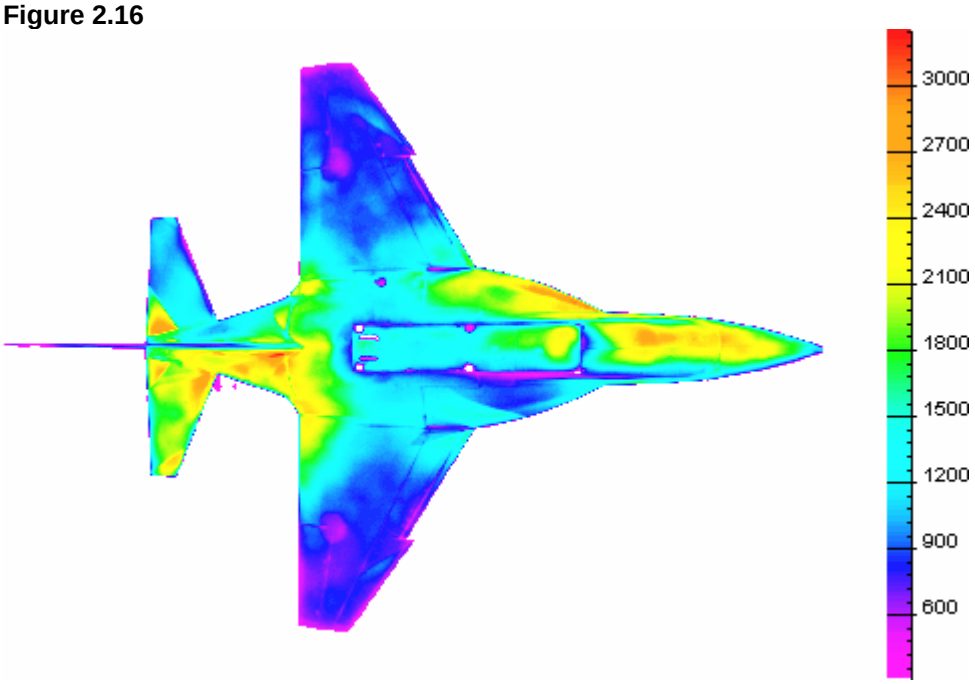
20. Click the **OK** control button. The bitmaps will be corrected.

Figure 2.15



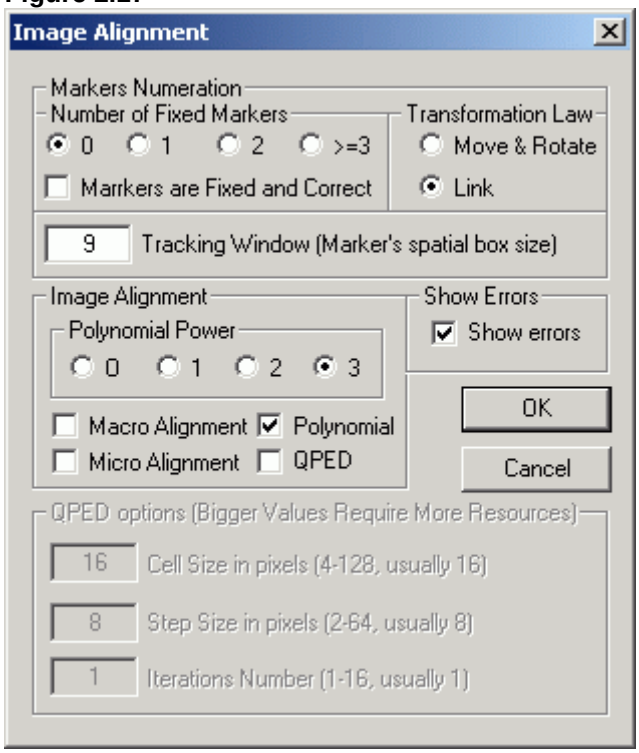
21. Choose the **Distortion Correction** command from the **B Convert** menu to compensate for objective-lens distortions of the bitmaps. This command may be used only once. Then it becomes inactive.

Figure 2.16



22. Choose the **Alignment Images...** command from the **B Convert** menu to align the bitmaps. The ***Image Alignment Dialog*** will appear on your screen.

Figure 2.17

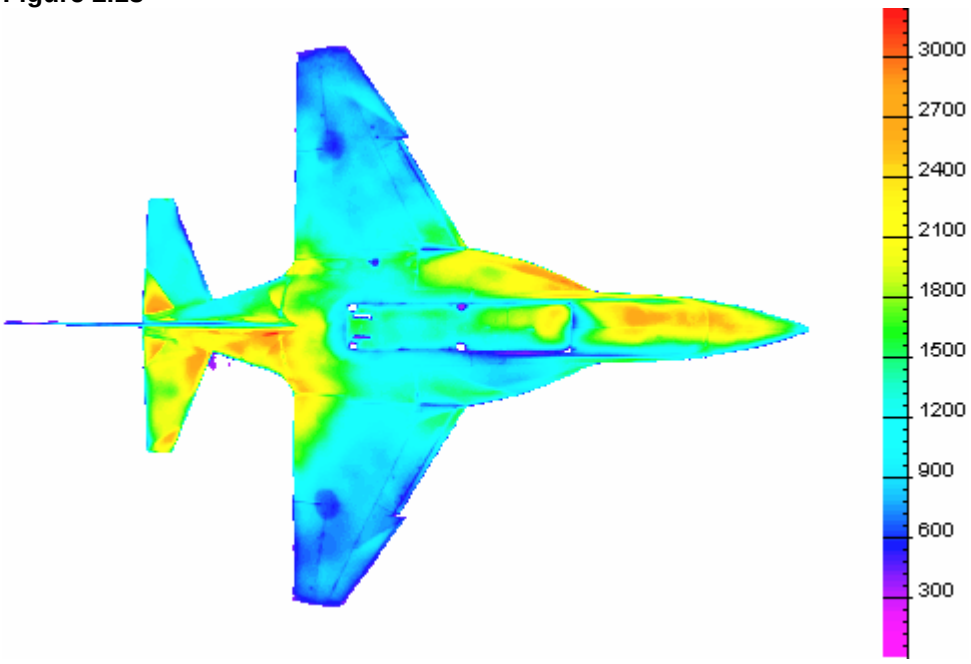


23. Choose all of the needed parameters in the ***Image Alignment Dialog*** as shown above.

24. Click the **OK** control button. Warning messages about the transformation error will appear on the screen.

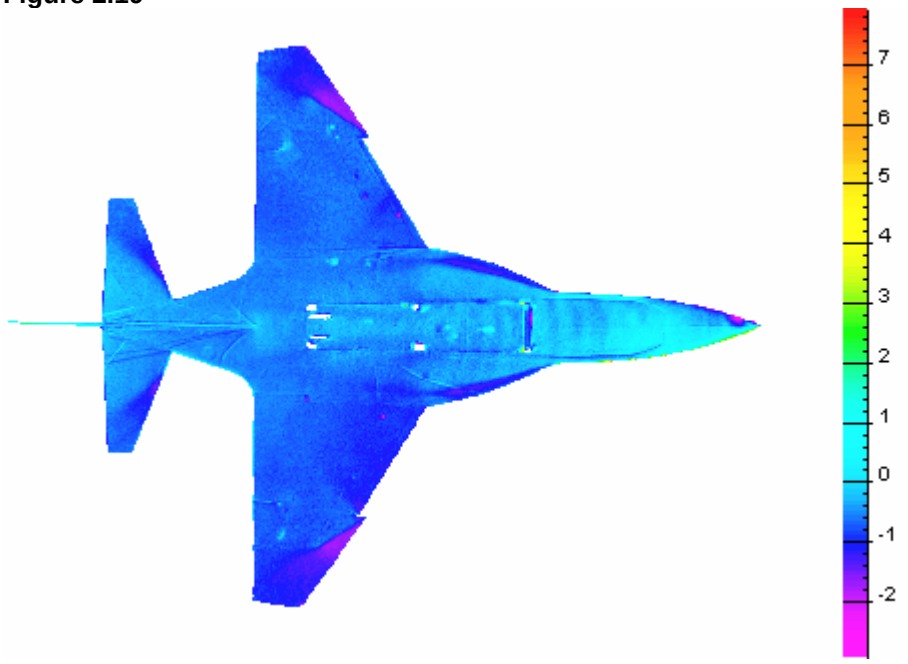
25. Click the **OK** control button, or press Enter. Four aligned bitmaps will be created (wind-off reference, wind-on reference, wind-off sensitive, and wind-on sensitive). Use the **Image** command from the **View** menu to switch between these bitmaps.

Figure 2.18



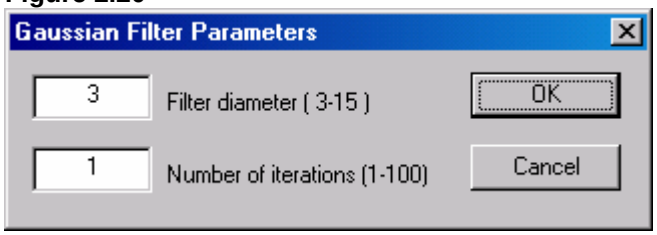
26. Choose the **Image Convert** command from the **B Convert** menu to transform the intensity on the aligned bitmaps to the physical parameters. Four bitmaps will be created (ratio of the intensity on the reference bitmap to the intensity on the sensitive bitmap, pressure, ratio of the pressure to the static pressure, and Cp). Use the **Image** command from the **View** menu to switch between these bitmaps. The Cp flowfield is shown below.

Figure 2.19



27. Choose the **Final Filtering...** command from the **B Convert** menu to apply the 2D Gauss filter on the bitmaps with physical parameters. The ***Gaussian Filter Parameters Dialog*** will appear on your screen.

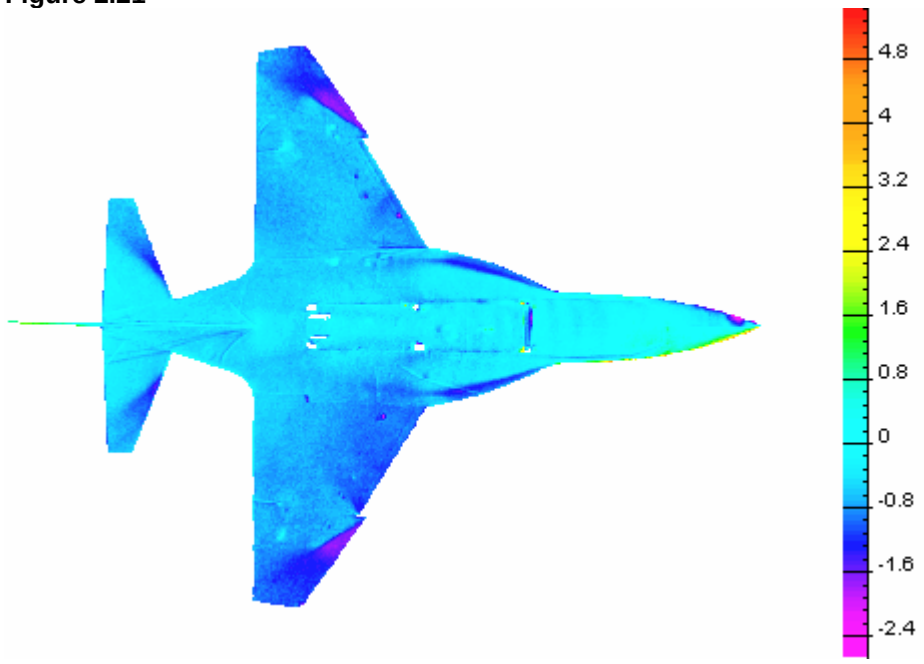
Figure 2.20



28. Choose all of the needed parameters in the ***Gaussian Filter Parameters Dialog*** as shown above.

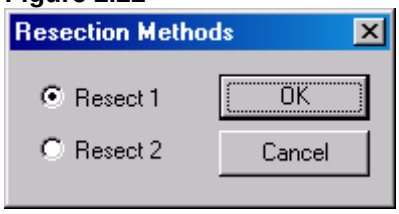
29. Click the **OK** control button. The corrected bitmap with the Cp flowfield will appear on your screen.

Figure 2.21



30. Choose the **Resection...** command from the **B Convert** menu to map the 2D bitmaps (with physical parameters) on the 3D mesh that describes the model surface. The ***Resection Methods Dialog*** will appear on your screen.

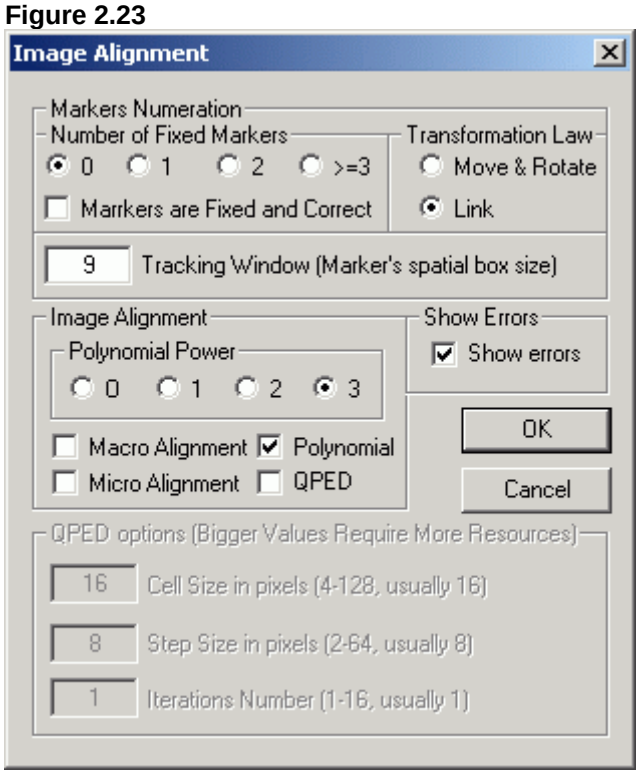
Figure 2.22



31. Choose all of the needed parameters in the ***Resection Methods Dialog*** as shown above.

32. Click the **OK** control button. The ***Image Alignment Dialog*** will appear on your screen.

Figure 2.23

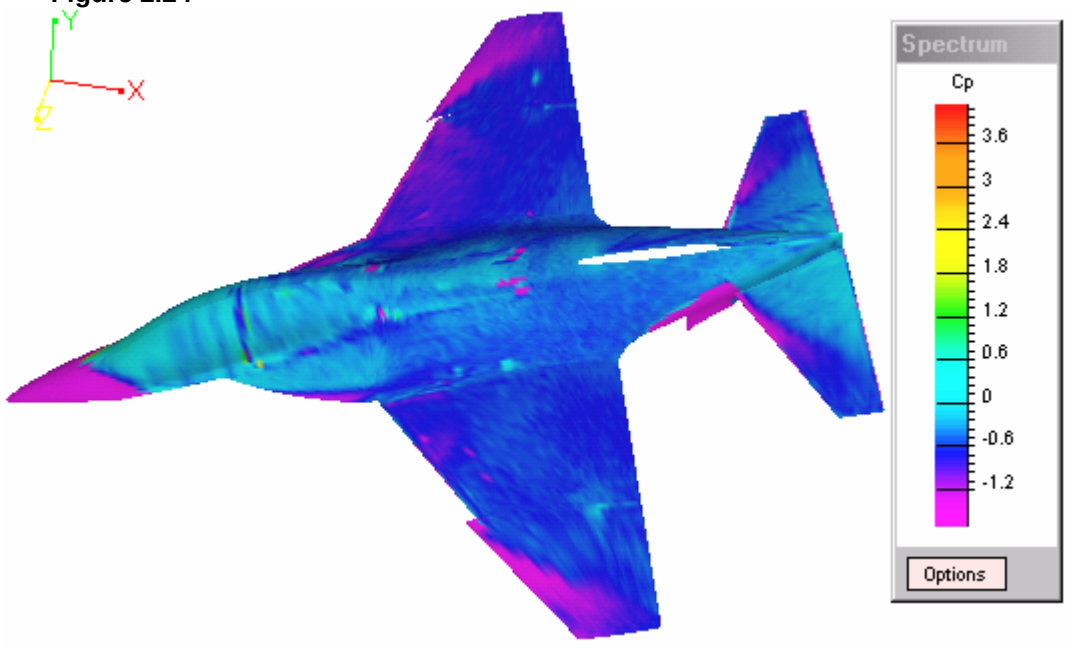


33. Choose all of the needed parameters in the ***Image Alignment Dialog*** as shown above.

34. Click the **OK** control button. The warning messages concerning the transformation error will appear on the screen.

35. Click the **OK** control button, or press Enter. The 3D flowfields will be created. For visualization it is necessary to open the file STEP_2.XYZ (it is created at Step 36) using the *ProField* application.

Figure 2.24



36. Choose the **Save Results** command from the **B Convert** menu to save the active project and the results of the data processing. Four bitmaps will be written on the disk (STEP_2_P_TO_PST.IMP, STEP_2_IREFE_ISENS.IMP, STEP_2_PRESSURE.IMP, and STEP_2_CP.IMP). These files contain the bitmaps of the physical parameters and the markers on them. Also the file with 3D flowfields will be written on the disk (STEP_2.XYZ).

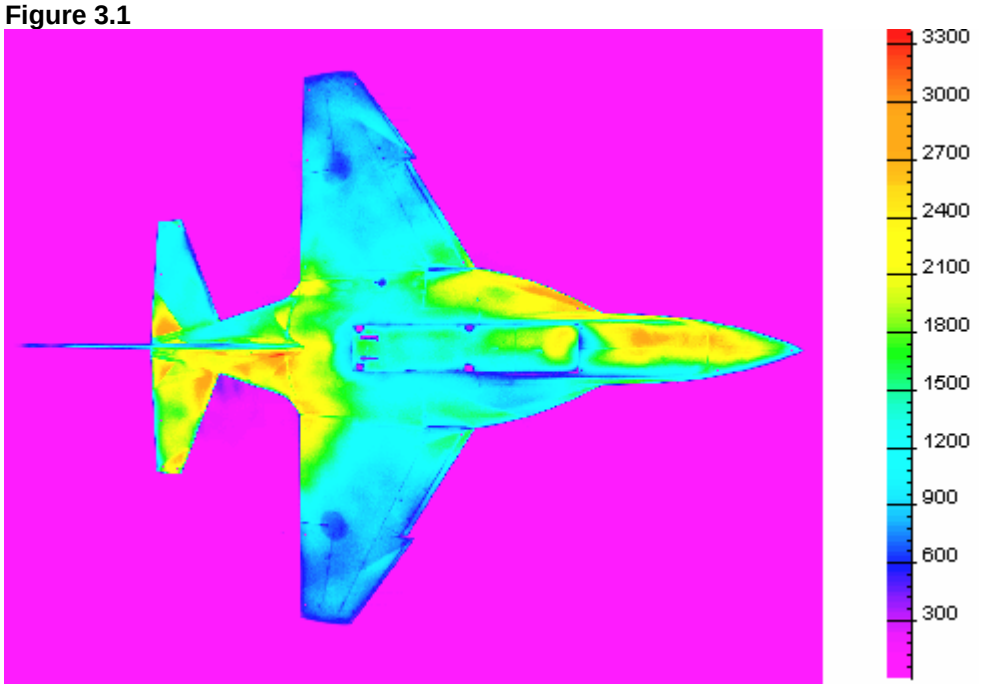
37. Choose the **Close Project** command from the **B Convert** menu to close the project file.

Step 3. Processing a Project Automatically

Subfolder SAMPLES\STEP_3 of the current folder contains all of the files necessary to process the project (for additional information see Step 2).

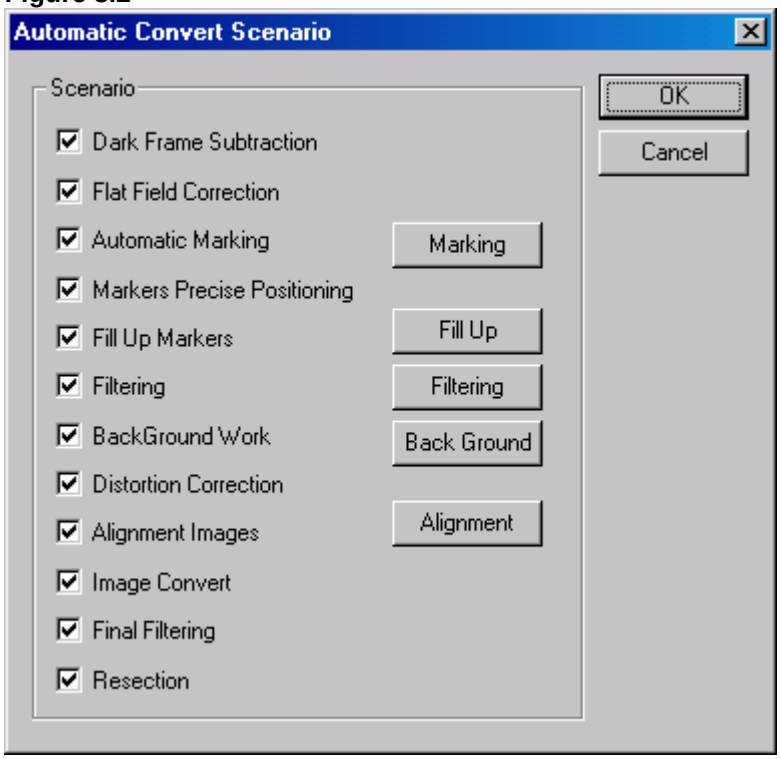
1. Open an existing file STEP_3.IMS that is located in subfolder SAMPLES\STEP_3 of the current folder (for additional information see Steps 1-2 of **Step 2**.) The wind-on sensitive bitmap will appear on your screen.

Figure 3.1



2. Choose the **Automatic Convert...** command from the **B Convert** menu. The ***Automatic Convert Scenario Dialog*** will appear on your screen.

Figure 3.2



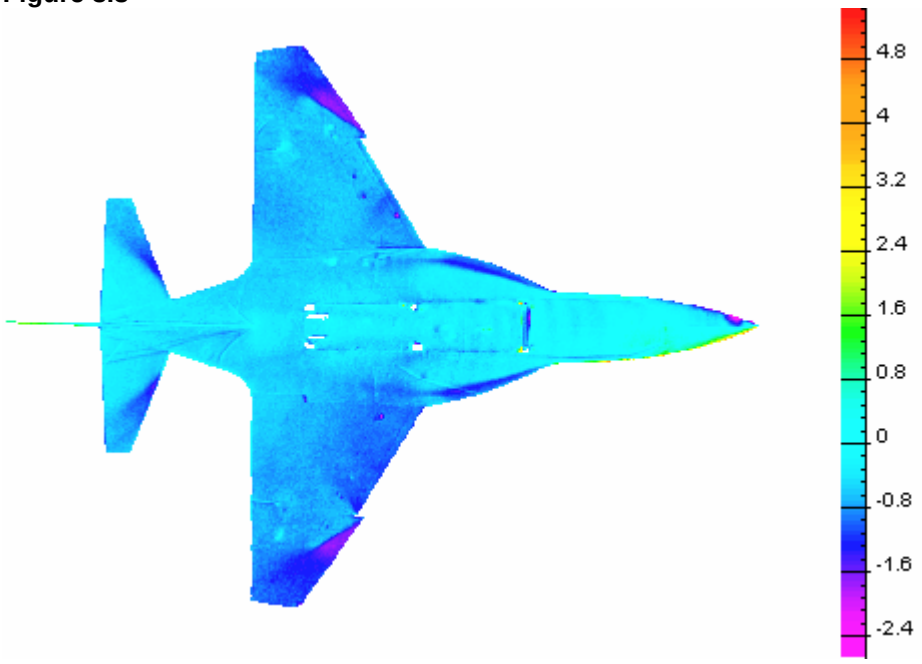
3. Choose all of the needed parameters in the ***Automatic Convert Scenario Dialog*** as shown above.

4. Click the **OK** control button. Steps 3-35 of **Step 2** will be performed. Default parameters will be used in the Dialogs. To change them you may click the necessary control buttons, and the appropriate Dialog will appear on your screen.

   Four bitmaps will be created (ratio of the intensity on the reference bitmap to the intensity on the sensitive bitmap, pressure, ratio of the pressure to the static pressure, and Cp). Use the **Image** command from the **View** menu to switch between these bitmaps. Also 3D flowfields will be created.

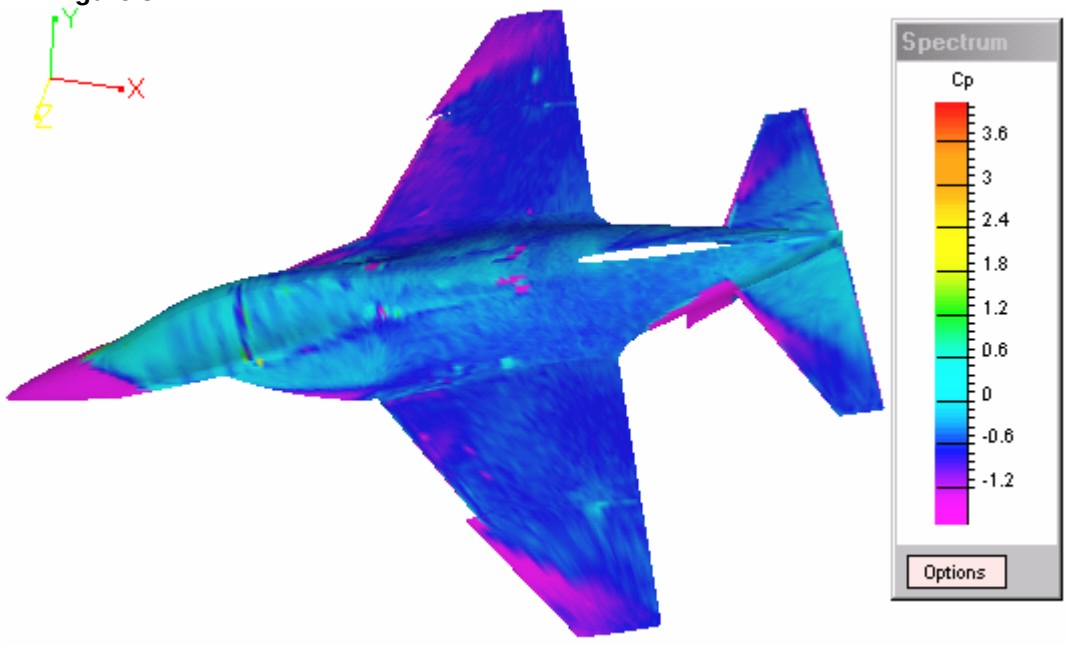
   The Cp flowfield is shown below.

Figure 3.3



5. Choose the **Save Results** command from the **B Convert** menu to save the active project and the results of the data processing. Four bitmaps will be written on the disk (STEP_3_P_TO_PST.IMP, STEP_3_IREFE_ISENS.IMP, STEP_3_PRESSURE.IMP, and STEP_3_CP.IMP). These files contain the bitmaps of the physical parameters and the markers on them. Also the file with 3D flowfields will be written on the disk (STEP_3.XYZ). For visualization it is necessary to open the file STEP_3.XYZ using the *ProField* application.

Figure 3.4



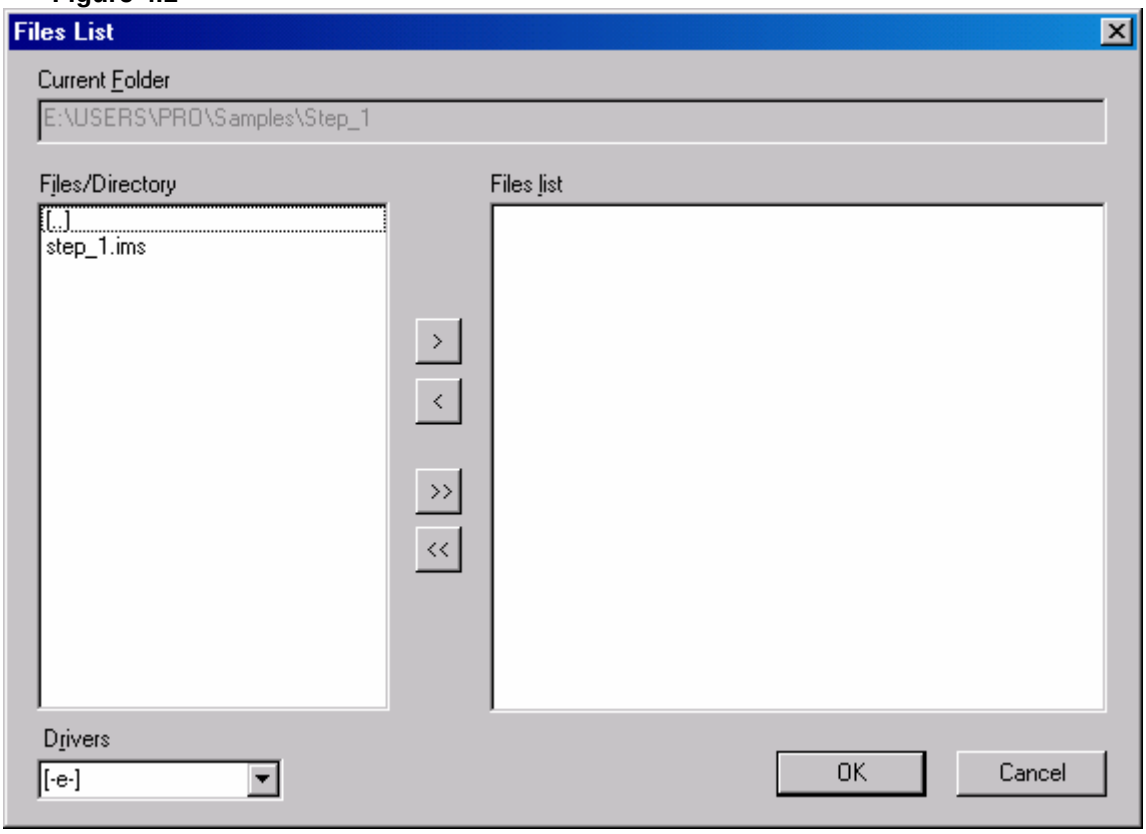
6. Choose the **Close Project** command from the **B Convert** menu to close the project file.

Step 4. Processing a List of Projects Automatically

Subfolder SAMPLES\STEP_3 of the current folder contains all of the files necessary to process the project (for additional information see Step 2). The project files from subfolders SAMPLES\STEP_1, SAMPLES\STEP_2, and SAMPLES\STEP_3 will be processed.

1. Choose the **Automatic Convert List...** command from the **B Convert** menu. The ***Automatic Convert Scenario Dialog*** will appear on your screen.

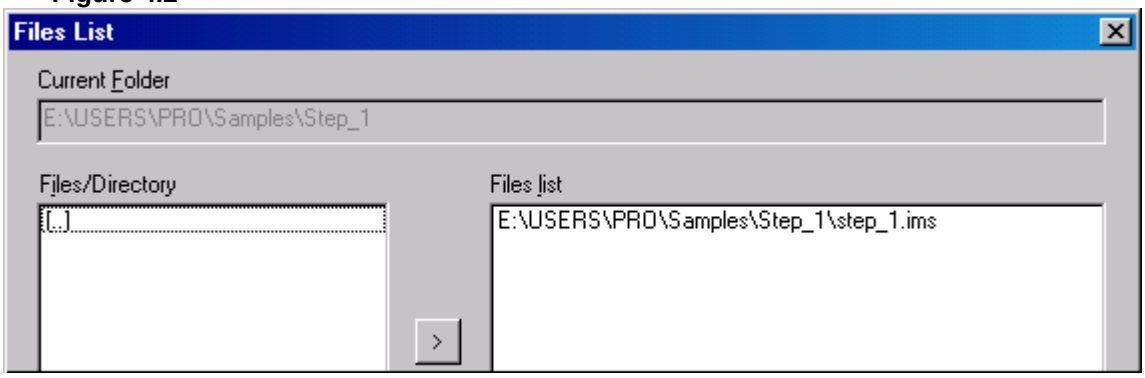
Figure 4.1



2. Select the STEP_1.IMS file in the **Files/Directory** list using the mouse.

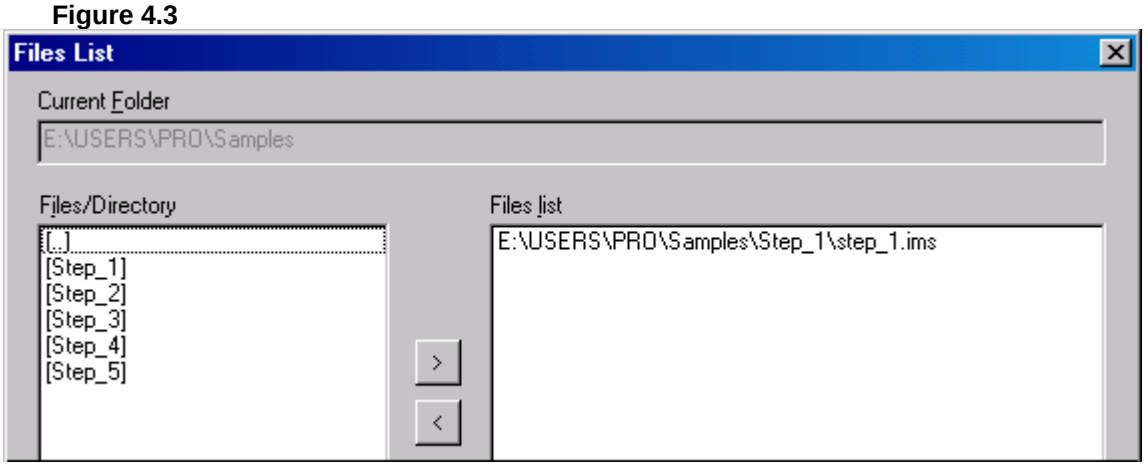
3. Click the > control button. This file will be placed in the **Files list** pane.

Figure 4.2



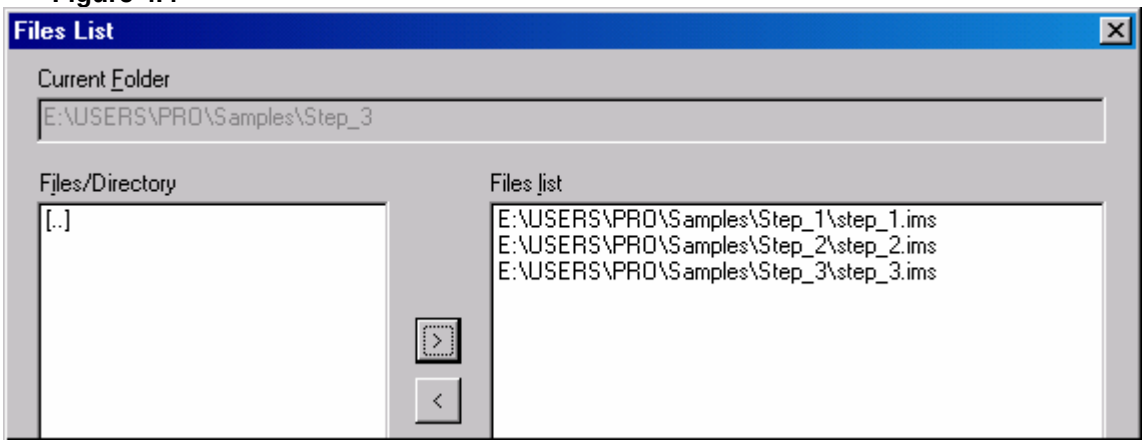
4. Double click the **[..]** in the **Files/Directory** list. The list of folders in the SAMPLES folder will appear on your screen.

Figure 4.3



5. Repeat Steps 2-4 to select the STEP_2.IMS file from the SAMPLES\STEP_2 folder and the STEP_3.IMS file from the SAMPLES\STEP_3 folder.

Figure 4.4



6. Click the **OK** control button. Three project files will be processed automatically. Steps 3-35 of **Step 2** will be performed. Default parameters will be used in the Dialogs. To change these you may click the necessary control buttons, and the appropriate Dialog will appear on your screen.

   Four bitmaps for each project file will be created (ratio of the intensity on the reference bitmap to the intensity on the sensitive bitmap, pressure, ratio of the pressure to the static pressure, and Cp). They will be written on the disk into the appropriate folder. These files contain the bitmaps of the physical parameters and the markers on them.

   Also 3D flowfields for each project file will be created. These files with 3D flowfields will be written on the disk into the appropriate folder.

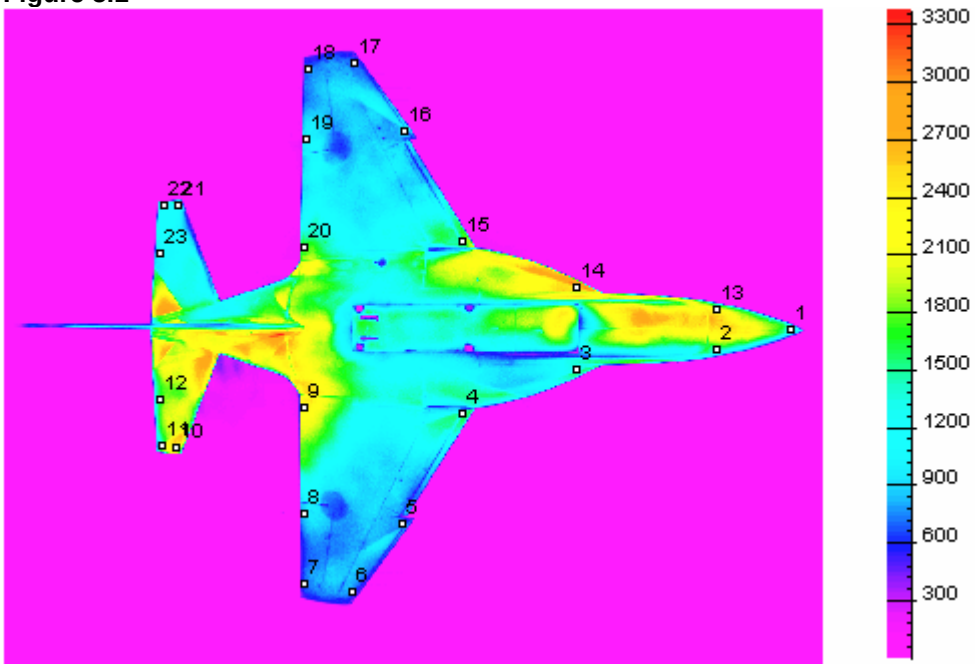
Step 5. Influence of Dialog Parameters on the Results of Project Processing

Subfolder SAMPLES\STEP_5 of the current folder contains the same files as SAMPLES\STEP_2, except that it contains a file for the Flat Field Correction and the following files with markers on the bitmaps:

1) REFE_OFF.MPT – markers on the wind-off reference bitmap;
2) SENS_OFF.MPT – markers on the wind-off sensitive bitmap;
3) REFE_ON.MPT – markers on the wind-on reference bitmap;
4) SENS_ON.MPT – markers on the wind-on sensitive bitmap.

1. Open an existing file STEP_5.IMS that is located in subfolder SAMPLES\STEP_5 of the current folder (for additional information see Steps 1-2 of **Step 2**). The wind-on sensitive bitmap will appear on your screen.

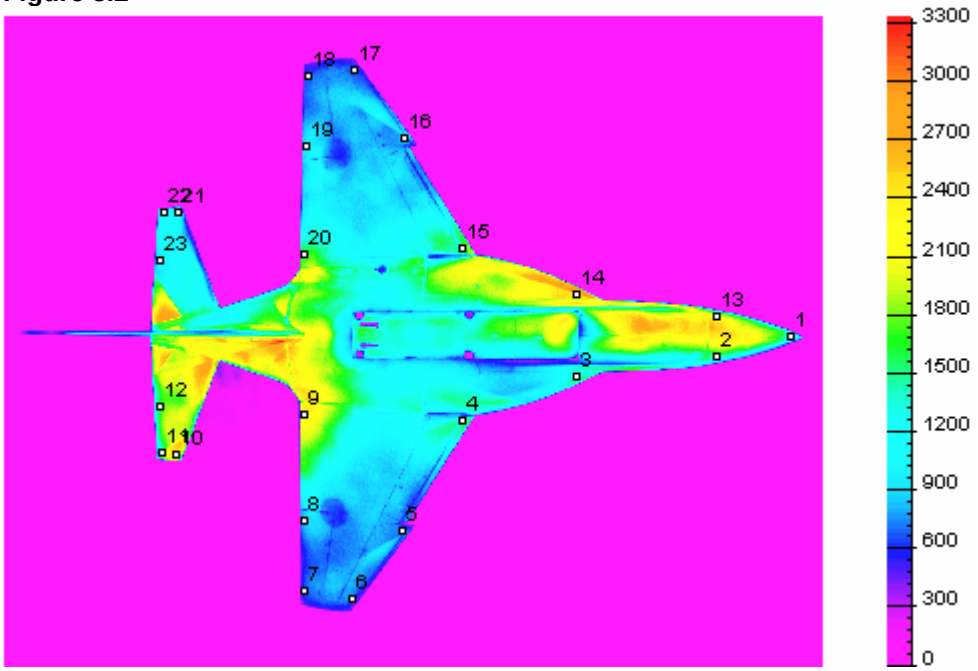
Figure 5.1



2. Choose the **Dark Frame Subtraction** command from the **B Convert** menu to subtract the dark bitmaps from the processed bitmaps. The corrected wind-on sensitive bitmap will appear on your screen. (Four bitmaps--wind-off reference, wind-on reference, wind-off sensitive,

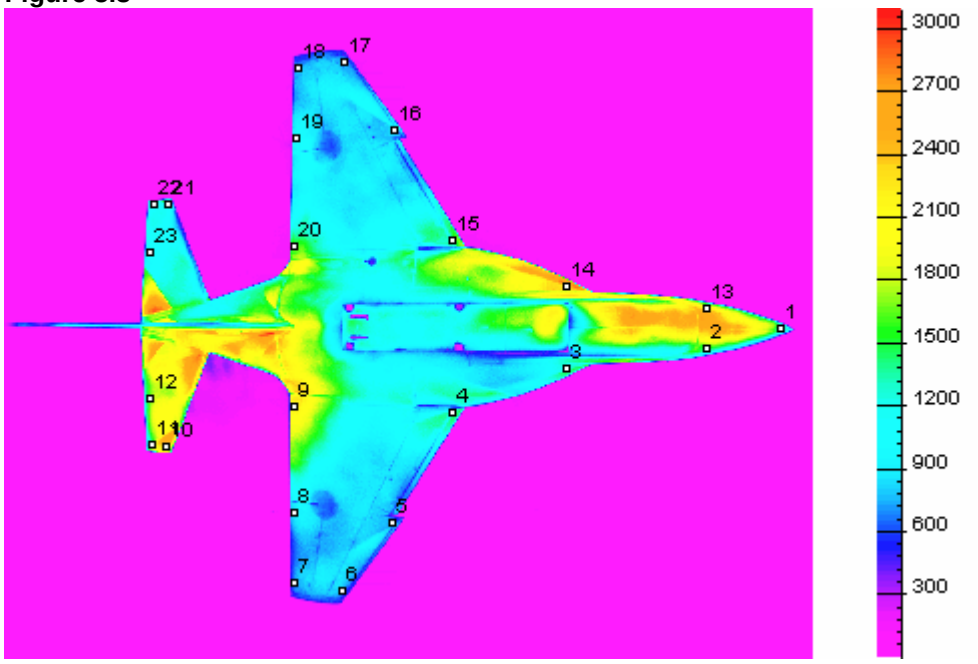
and wind-on sensitive--will be corrected. Use the **Image** command from the **View** menu to switch between these bitmaps.)

Figure 5.2



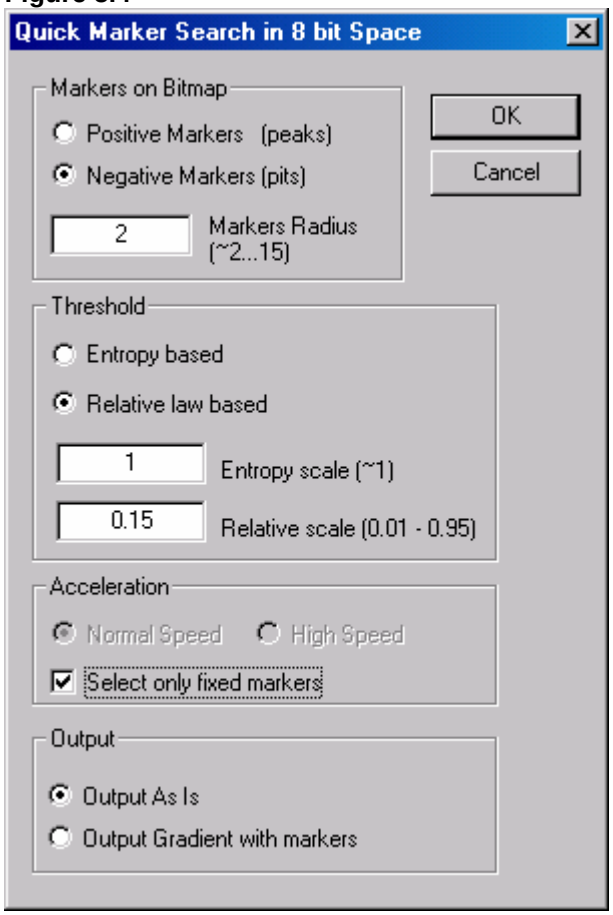
3. Choose the **Flat Field Correction** command from the **B Convert** menu to compensate for distortions of the videocamera objective lens and the spread of the sensitivity of the photodetector array. The corrected wind-on sensitive bitmap will appear on your screen. (Four bitmaps--–wind-off reference, wind-on reference, wind-off sensitive, and wind-on sensitive--will be corrected. Use the **Image** command from the **View** menu to switch between these bitmaps.)

Figure 5.3



4. Choose the **Automatic Marking...** command from the **B Convert** menu. The ***Quick Marker Search Dialog*** will appear on your screen.

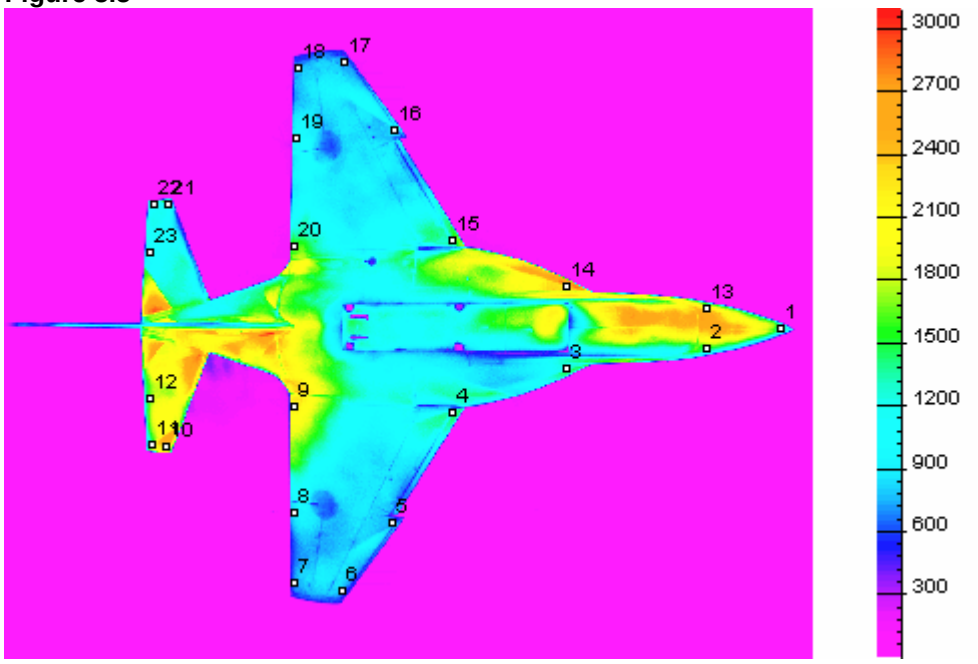
Figure 5.4



5. Choose all of the needed parameters in the ***Quick Marker Search Dialog*** as shown above. In the case of chosen parameters (the **Select only fixed markers** check box is turned on), only fixed markers will be copied.

6. Click the **OK** control button. Four bitmaps with markers will be created (wind-off reference, wind-on reference, wind-off sensitive, and wind-on sensitive). Use the **Image** command from the **View** menu to switch between these bitmaps.

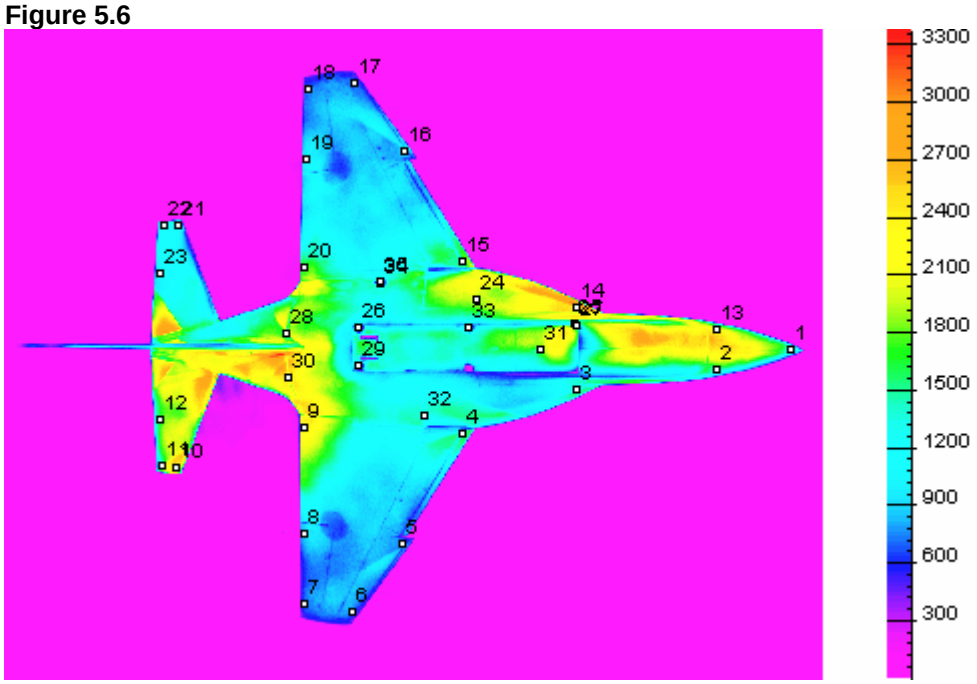
Figure 5.5



7. Choose the **Automatic Marking...** command from the **B Convert** menu. The ***Quick Marker Search Dialog*** will appear on your screen again.

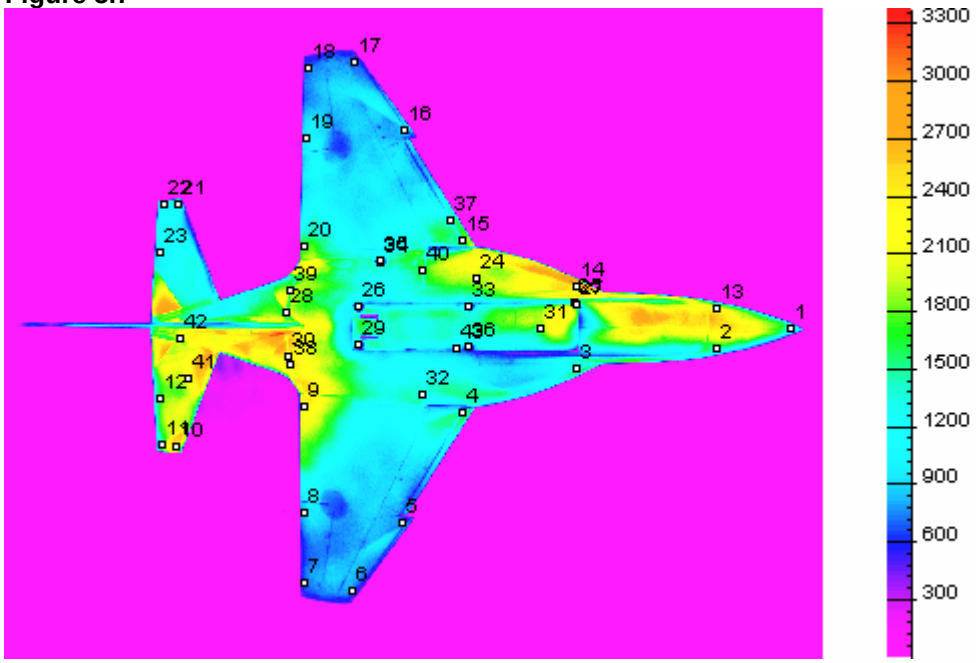
8. Turn off the **Select only fixed markers** check box; type "7" in the **Markers Radius** text box; and click the **OK** control button. The number of markers will more than **Markers Radius** is equal to "2".

Figure 5.6



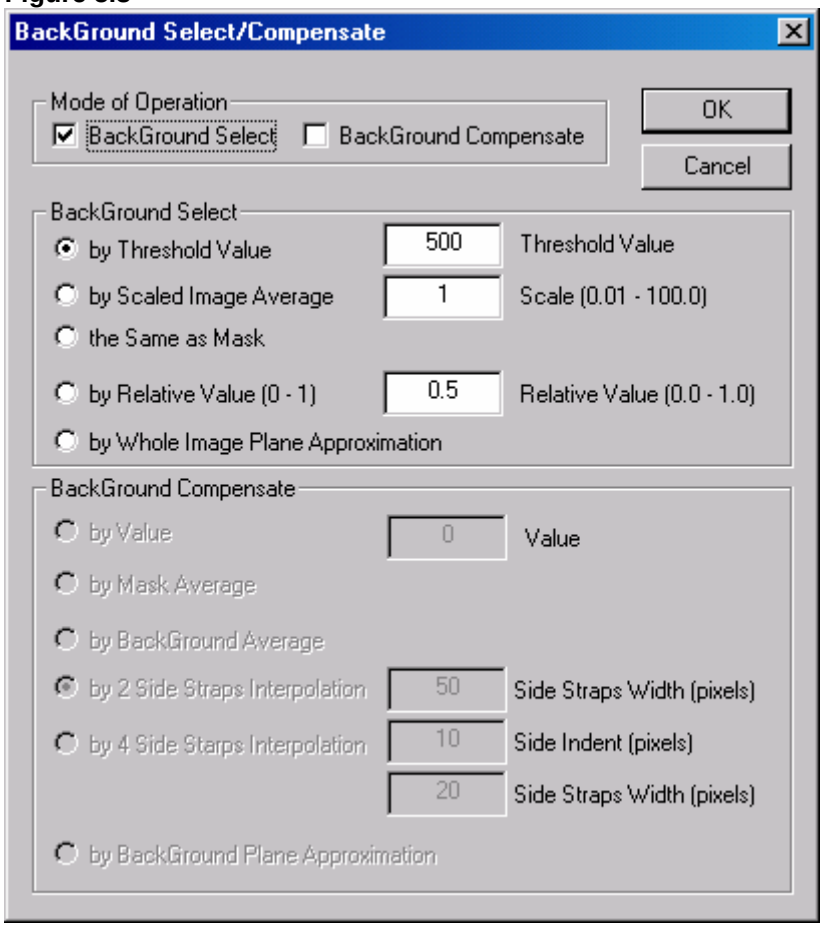
9. Choose the **Automatic Marking...** command from the **B Convert** menu. The ***Quick Marker Search Dialog*** will appear on your screen again.
10. Turn on the **Output As Is** radio button in the **Output** pane and the **Entropy Based** radio button in the **Threshold** pane. Click the **OK** control button. The number of markers will increase.

Figure 5.7



11. Choose the **BackGround Work...** command from the **B Convert** menu to remove the background on the bitmaps. The ***BackGround Select/Compensate Dialog*** will appear on your screen.

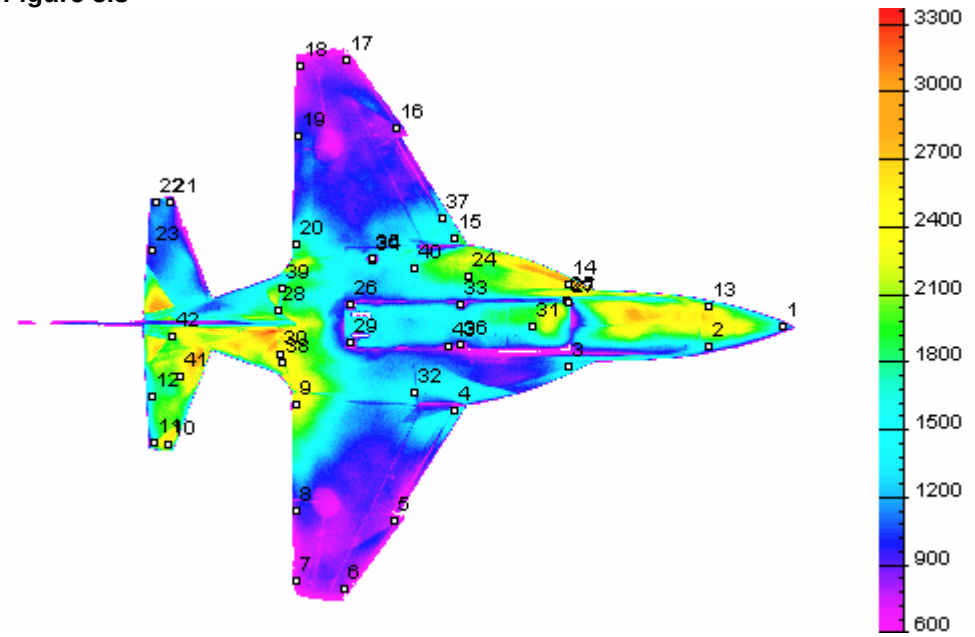
Figure 5.8



12. Choose all of the needed parameters in the ***BackGround Select/Compensate Dialog*** as shown above.

13. Click the **OK** control button. All of the intensities on the bitmaps that are less than 500 will become background.

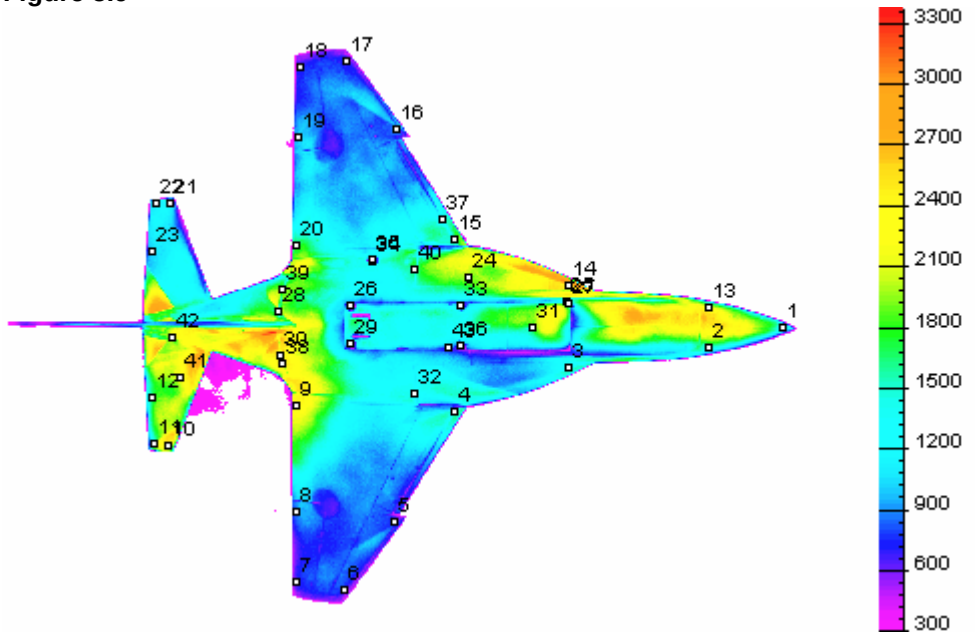
Figure 5.8



14. Choose the **BackGround Work...** command from the **B Convert** menu. The ***BackGround Select/Compensate Dialog*** will appear on your screen again.

15. Turn on the **by Scaled Image Average** radio button, and type "0.5" in the **Scale** text box in the **BackGround Select** pane. Click the **OK** control button. All of the intensities on the bitmaps that are less than one-half of the average intensity will become background.

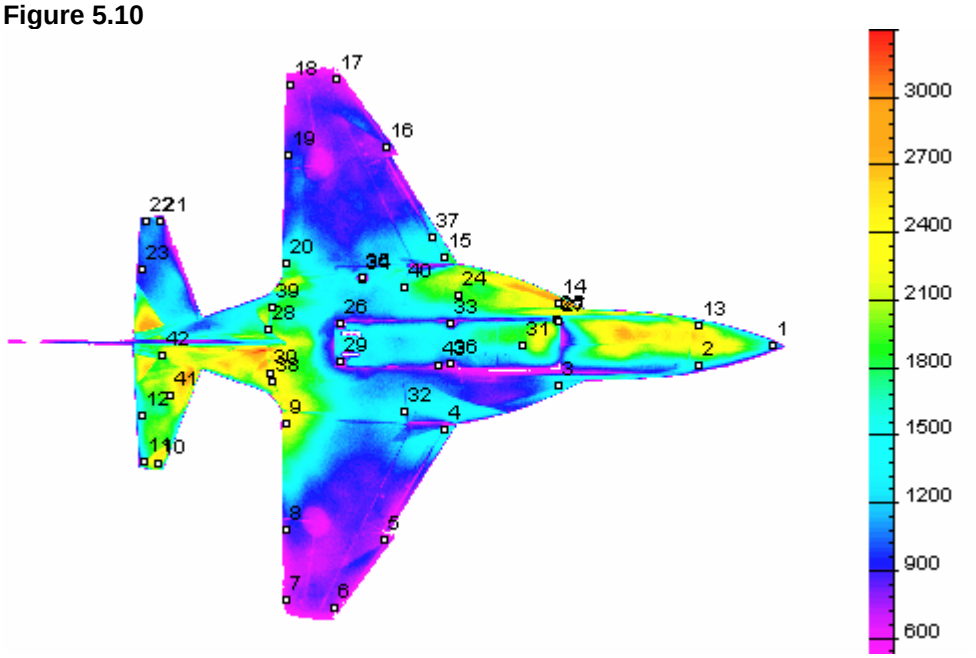
Figure 5.9



16. Choose the **BackGround Work...** command from the **B Convert** menu. The ***BackGround Select/Compensate Dialog*** will appear on your screen again.

17. Turn off the **BackGround Select** check box, and turn on the **BackGround Compensate** check box in the **Mode of Operation** pane. Type "60" in the **Value** text box. Click the **OK** control button. All of the intensities on the bitmaps will be diminished by 60.

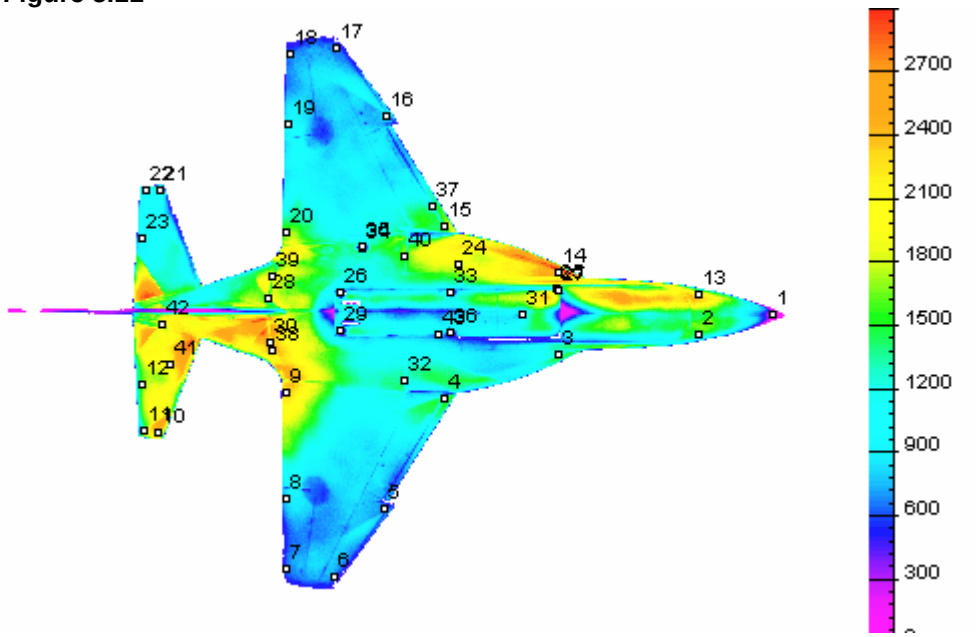
Figure 5.10



18. Choose the **BackGround Work...** command from the **B Convert** menu. The ***BackGround Select/Compensate Dialog*** will appear on your screen again.

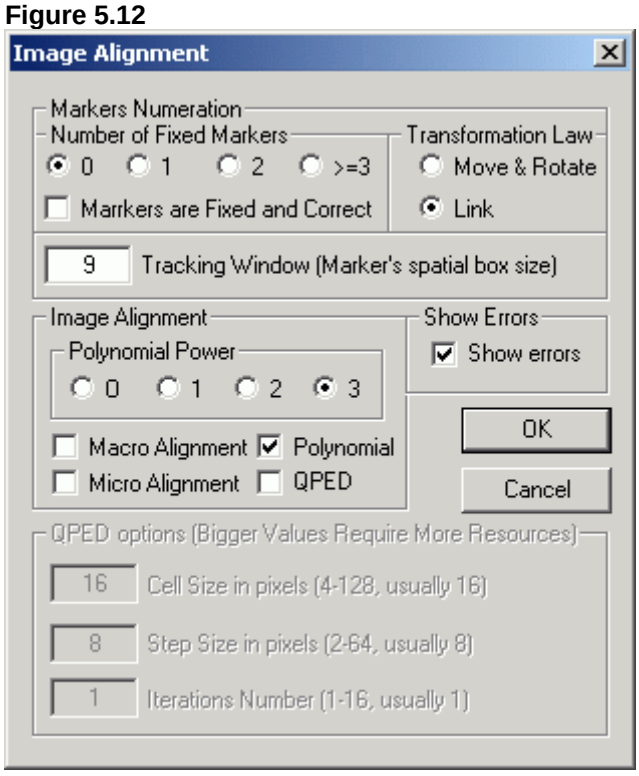
19. Turn on the **by 2 Sides Strap Interpolation** radio button, and type "50" in the **Side Straps Width** text box in the **BackGround Compensate** pane. Click the **OK** control button.

Figure 5.11



20. Choose the **Alignment Images...** command from the **B Convert** menu to align the bitmaps. The ***Image Alignment Dialog*** will appear on your screen.

Figure 5.12

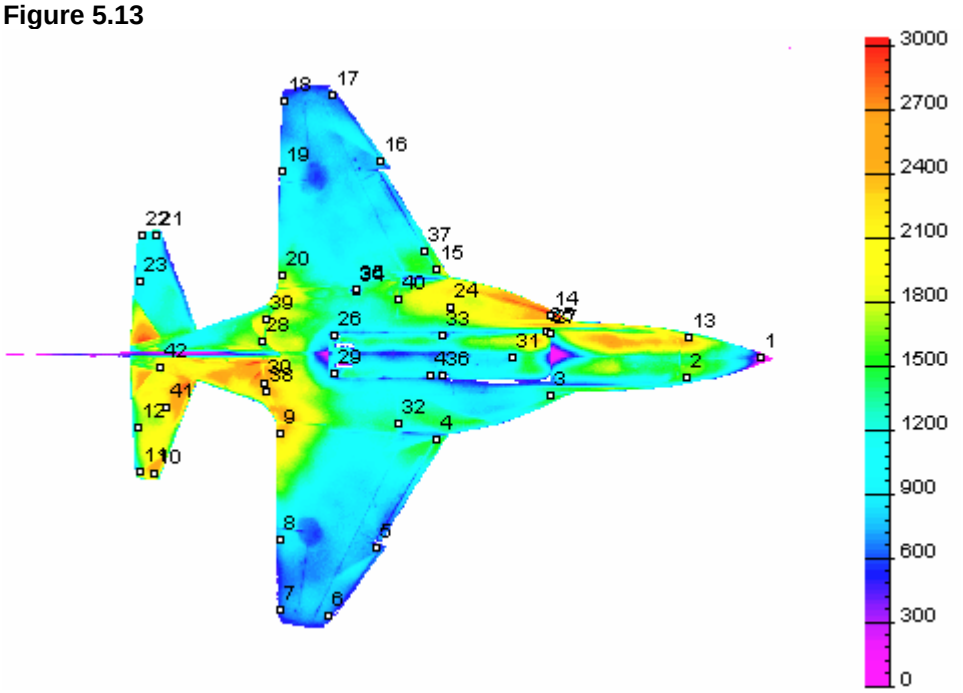


21. Choose all of the needed parameters in the ***Image Alignment Dialog*** as shown above.

22. Click the **OK** control button. Warning messages about the transformation error will appear on the screen.

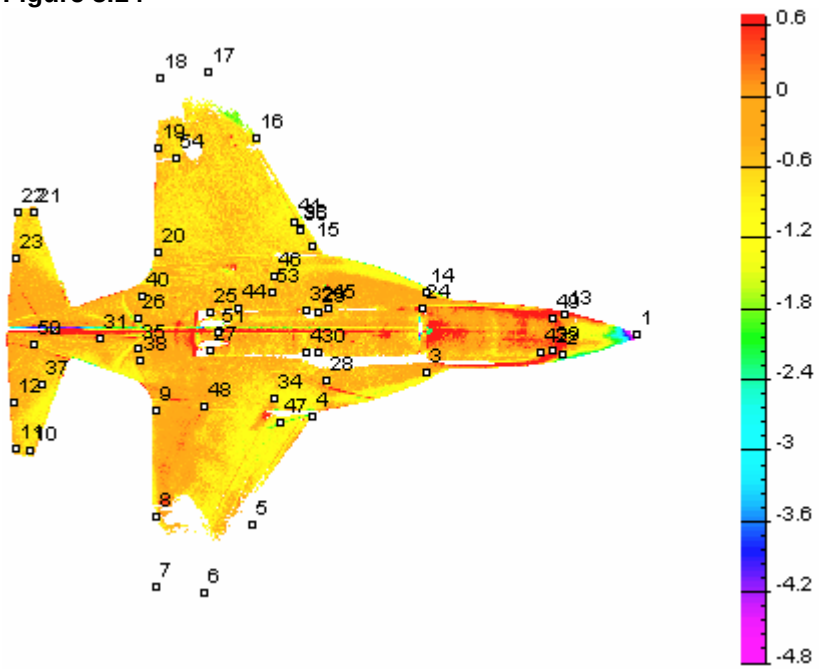
23. Click the **OK** control button, or press Enter. Four aligned bitmaps will be created (wind-off reference, wind-on reference, wind-off sensitive, and wind-on sensitive). Use the **Image** command from the **View** menu to switch between these bitmaps.

Figure 5.13



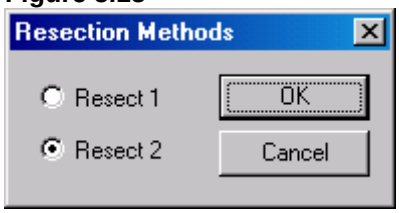
24. Choose the **Image Convert** command from the **B Convert** menu to transform the intensity on the aligned bitmaps to the physical parameters. Four bitmaps will be created (ratio of the intensity on reference bitmap to the intensity on the sensitive bitmap, pressure, ratio of the pressure to the static pressure, and Cp). Use the **Image** command from the **View** menu to switch between these bitmaps. The Cp flowfield is shown below.

Figure 5.14



25. Choose the **Resection...** command from the **B Convert** menu to map 2D bitmaps (with physical parameters) on the 3D mesh that describes the model surface. Then the ***Resection Methods Dialog*** will appear on your screen.

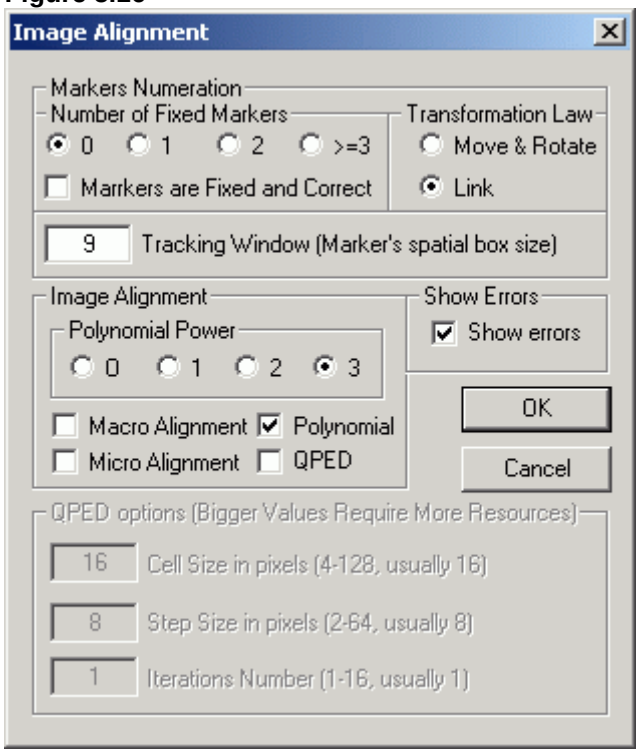
Figure 5.15



26. Choose all of the needed parameters in the ***Resection Methods Dialog*** as shown above.

27. Click the **OK** control button. The ***Image Alignment Dialog*** will appear on your screen.

Figure 5.16

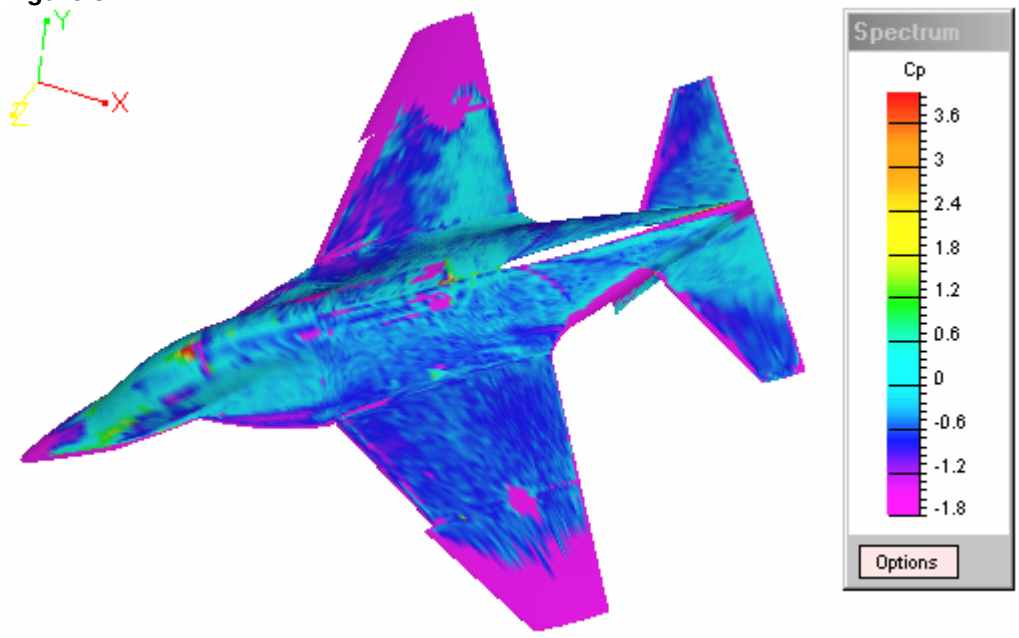


28. Choose all of the needed parameters in the ***Image Alignment Dialog*** as shown above.

29. Click the **OK** control button. Wwarning messages about the transformation error will appear on the screen.

30. Click the **OK** control button, or press Enter. The 3D flowfields will be created. For visualization it is necessary to open the file STEP_5.XYZ (it is created at Step 31) using the *ProField* application. An inaccurate Flowfield is caused by poor Alignment and poor Resection. The violet parts of the Flowfield are attributed to background due to discrepancy.

Figure 5.17



31. Choose the **Save Results** command from the **B Convert** menu to save the active project and the results of the data processing. Four bitmaps will be written on the disk (STEP_5_P_TO_PST.IMP, STEP_5_IREFE_ISENS.IMP, STEP_5_PRESSURE.IMP, and STEP_5_CP.IMP). These files contain the bitmaps of the physical parameters and the markers on them. Also the file with 3D flowfields will be written on the disk (STEP_5.XYZ).

32. Choose the **Close Project** command from the **B Convert** menu to close the project file.

Chapter 3. Editing a Single Bitmap

Step 6. Editing the Intensity Values on a Bitmap

1. After running *ProImage* open an existing bitmap STEP_6.P that is located in subfolder SAMPLES\STEP_6 of the current folder:

   - Choose the **Open...** command from the **File** menu,

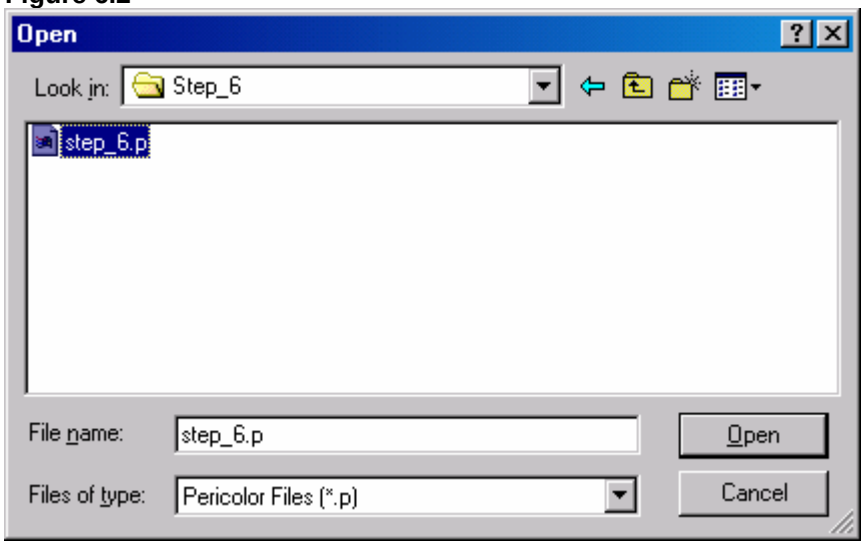
     or

   - Click the following icon from the upper toolbar:

Figure 6.1

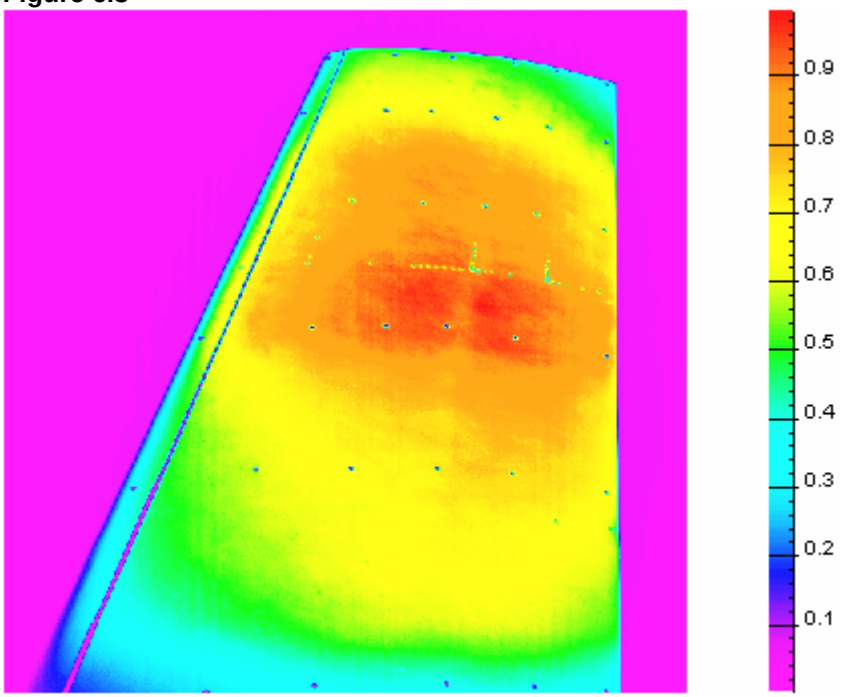
The standard ***Open Dialog*** will appear on your screen.

Figure 6.2



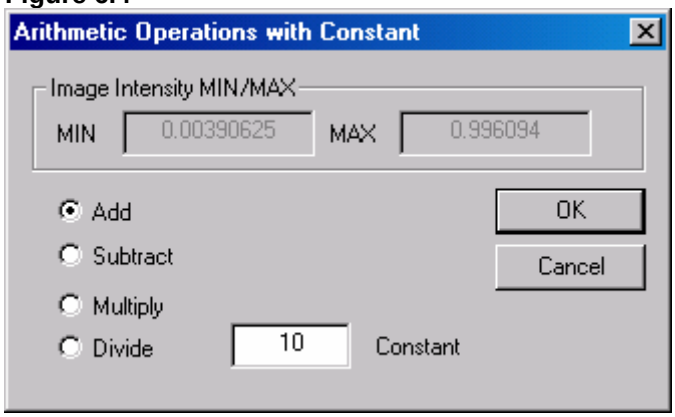
2. Choose the file STEP_6.P, and click the **Open** control button. The ***Open Dialog*** will be closed, and the bitmap will appear on your screen.

Figure 6.3



3. Choose the **Arithmetic...** command from the **Edit** menu. The ***Arithmetic Operations with Constant Dialog*** will appear on your screen.

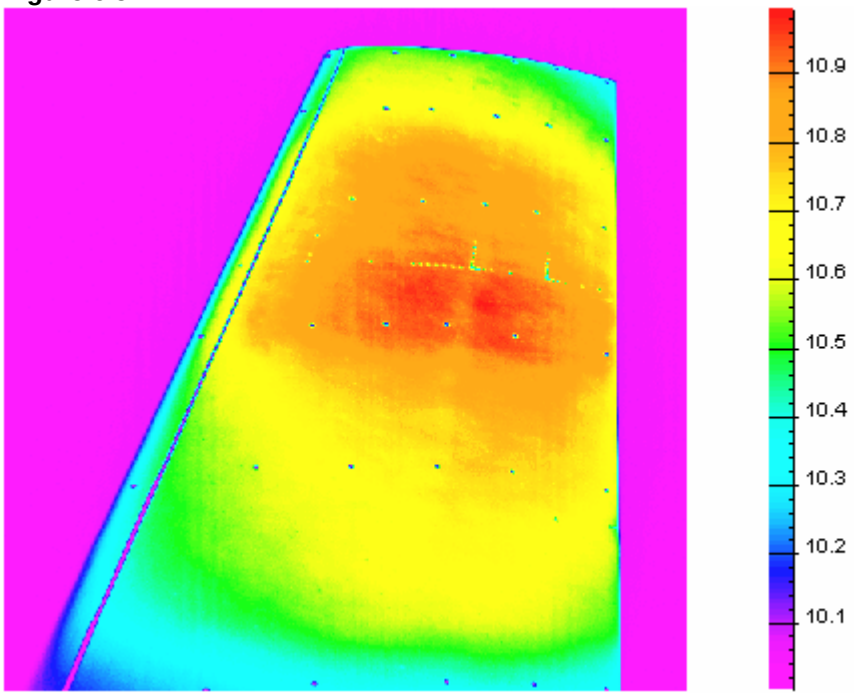
Figure 6.4



4. Choose all of the needed parameters in the ***Arithmetic Operations with Constant Dialog*** as shown above.

5. Click the **OK** control button. The palette in the right-hand portion of the application window will be changed, and the level of intensity on the bitmap will be increased by 10.

Figure 6.5



6. To create a mask region on the bitmap:

   Choose the **Mask by Boxes** command from the **Mask** menu,

   or

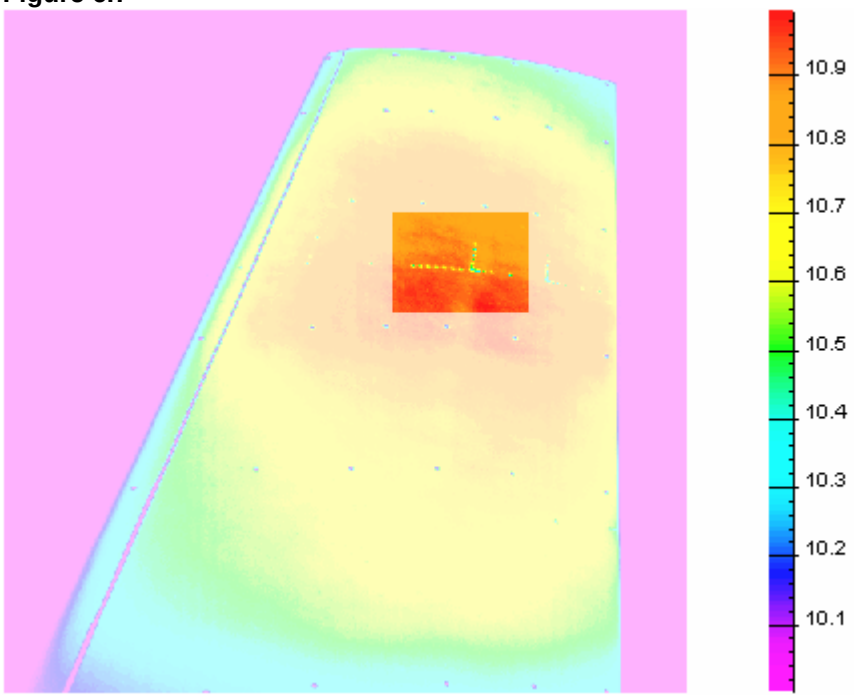
   Click the following icon from the upper toolbar:

Figure 6.6

The cursor shape will be changed to ⌖.

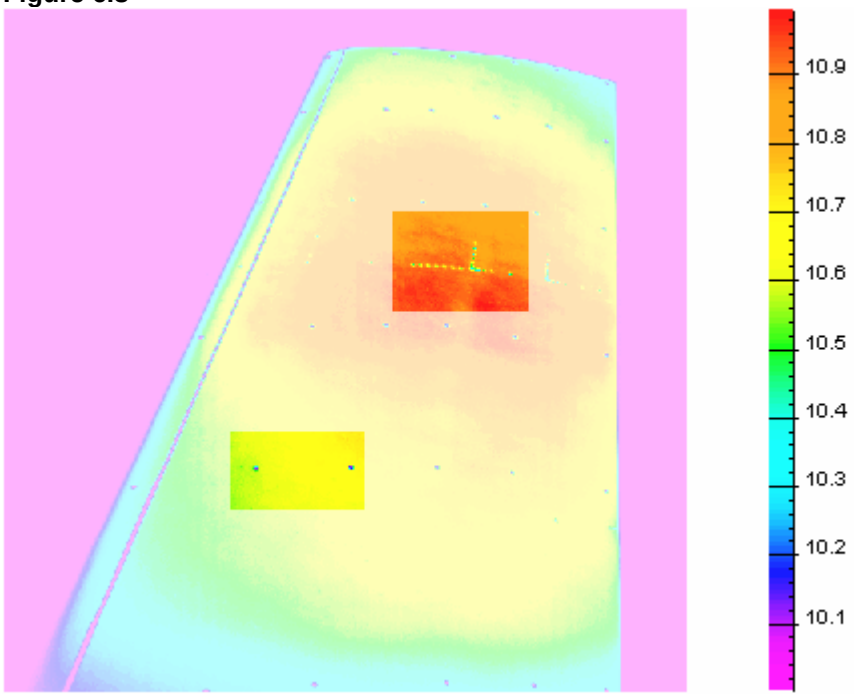
7. Press the left mouse button, and move the mouse. Choose the desired box size, and release the mouse. The selected part of bitmap will be represented with bright colors and the out-mask region with muted colors.

Figure 6.7



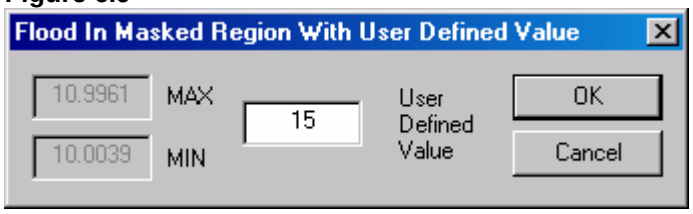
8. Repeat Step 6-7, and create an additional mask region on the bitmap.

Figure 6.8



9. Choose the **Flood in Masked Regions...** command from the **Edit** menu. The ***Flood In Masked Region With User Defined Value Dialog*** will appear on your screen.

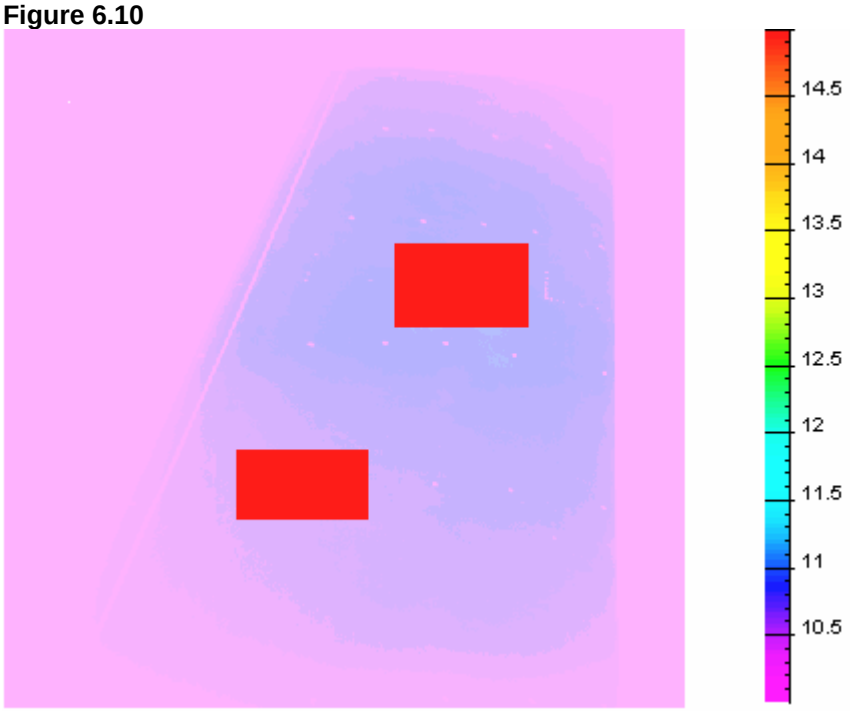
Figure 6.9



10. Choose all of the needed parameters in the ***Flood In Masked Region With User Defined Value Dialog*** as shown above.

11. Click the **OK** control button. The intensity in the masked regions will be equal to 15.

Figure 6.10

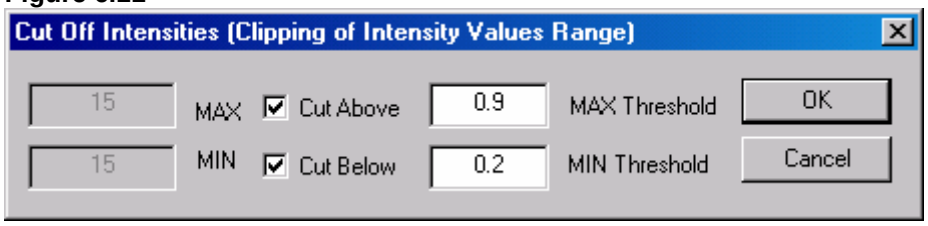


12. Choose the **Close** command from the **File** menu to close the bitmap.

13. Open an existing file STEP_6.P again (or more information see Steps 1-2). **Figure 6.3** will appear on your screen.

14. Choose the **Cut Off Intensities...** command from the **Edit** menu. The ***Cut Off Intensities Dialog*** will appear on your screen.

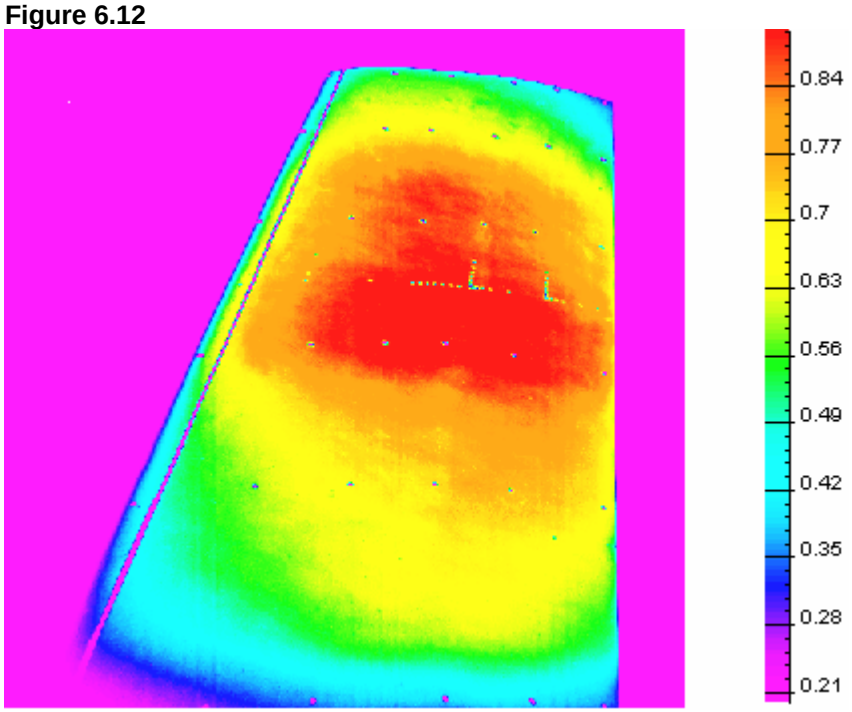
Figure 6.11



15. Choose all of the needed parameters in the ***Cut Off Intensities Dialog*** as shown above.

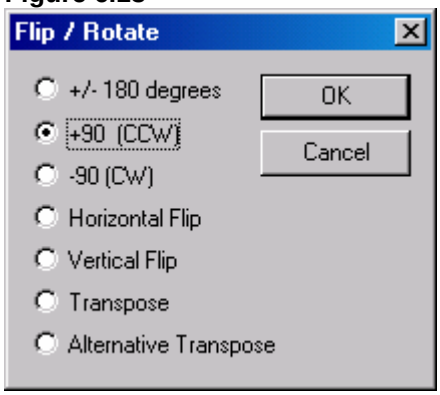
16. Click the **OK** control button. The palette in the right-hand portion of the application window will be changed, and the limits of intensity on the bitmap will be equal to 0.2 and 0.9.

Figure 6.12



17. To rotate the bitmap choose the **Flip/Rotate...** command from the **Edit** menu. The ***Flip/Rotate Dialog*** will appear on your screen.

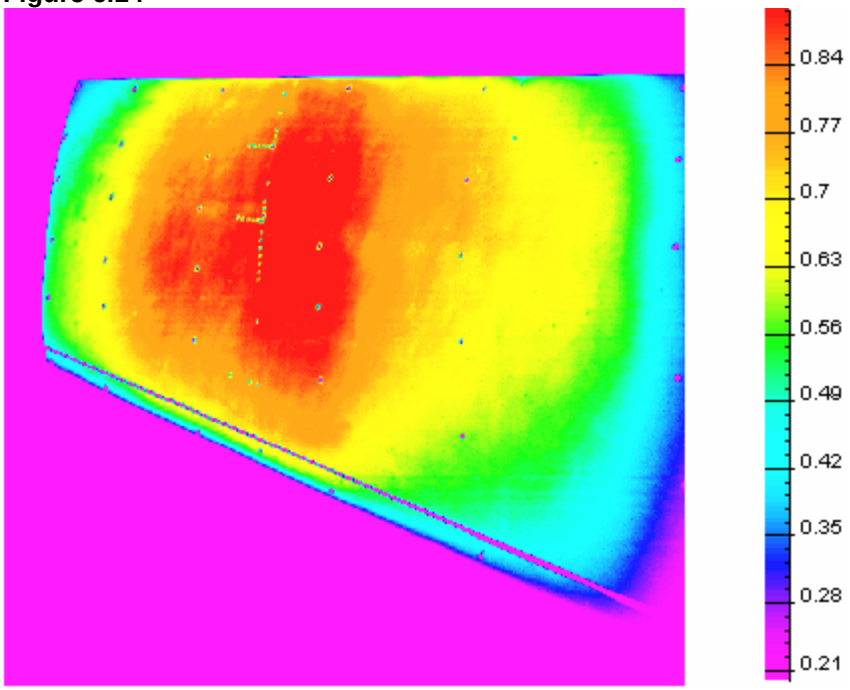
Figure 6.13



18. Choose all of the needed parameters in the ***Flip/Rotate Dialog*** as shown above.

19. Click the **OK** control button. The bitmap will be rotated.

Figure 6.14



20. To create a mask region on the bitmap:

    Choose the **Mask by Polygon** command from the **Mask** menu,

    or

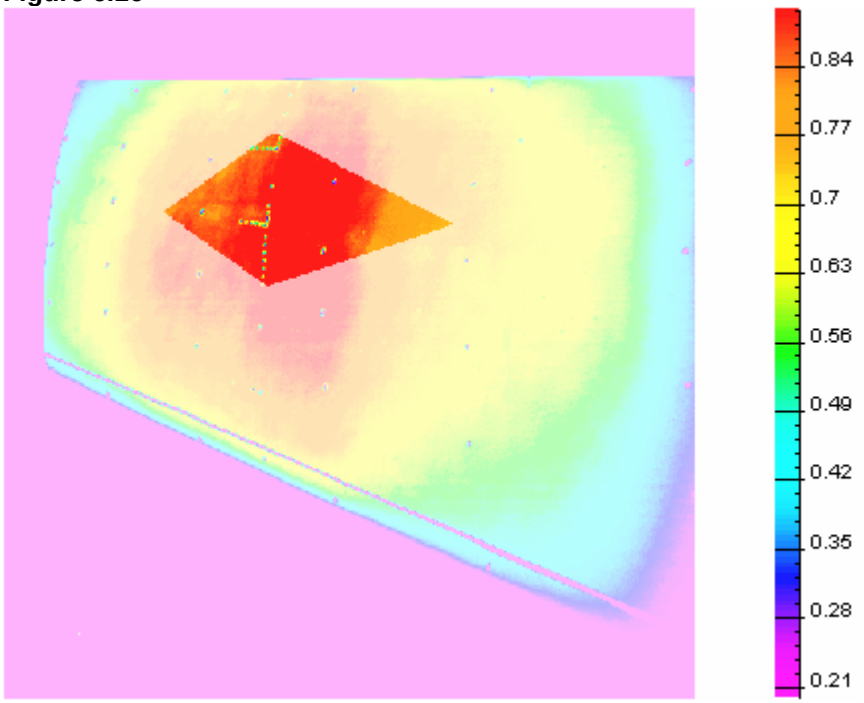
    Click the following icon from the upper toolbar:

Figure 6.15

The cursor shape will be changed to ⌖.

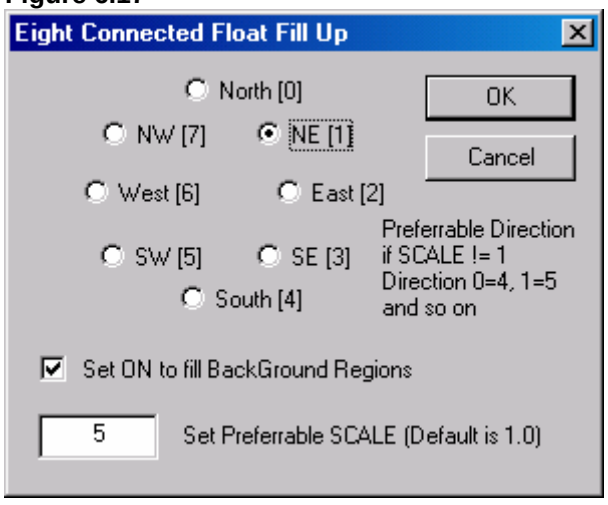
21. Click the mouse to fix the polyline nodes at some points. Click the mouse at the first node to close the polyline. The cursor shape will be changed to  . Click inside (outside) the polygon. The inner (outer) region of the bitmap will be represented with bright colors and the out-mask region with muted colors.

Figure 6.16



22. Choose the **Fill Up...** command from the **Edit** menu. The ***Eight Connected Float Fill Up Dialog*** will appear on your screen.

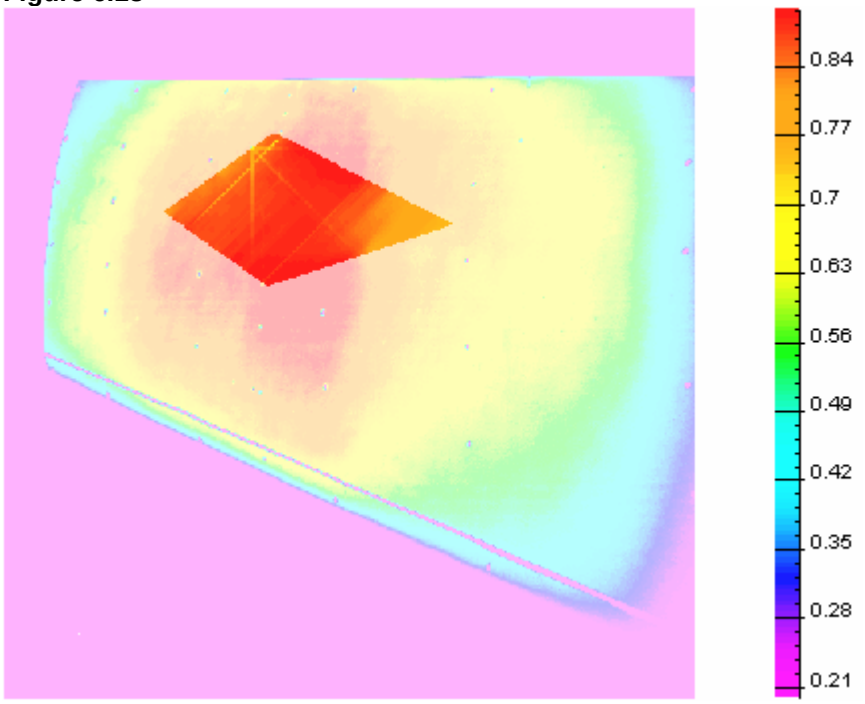
Figure 6.17



23. Choose all of the needed parameters in the ***Eight Connected Float Fill Up Dialog*** as shown above.

24. Click the **OK** control button. The intensity in the masked region will be changed using bilinear interpolation.

Figure 6.18

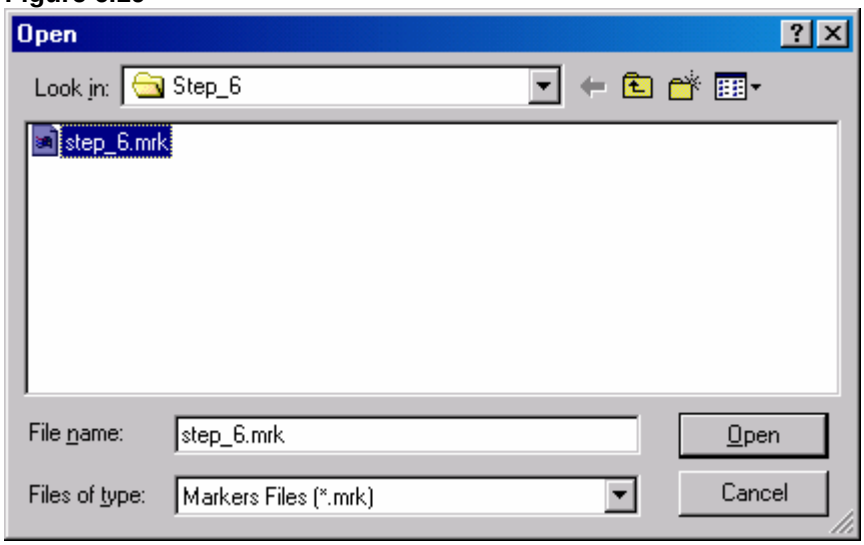


25. Choose the **Close** command from the **File** menu to close the bitmap.

26. Open an existing file STEP_6.P again (for additional information see Steps 1-2). **Figure 6.3** will appear on your screen.

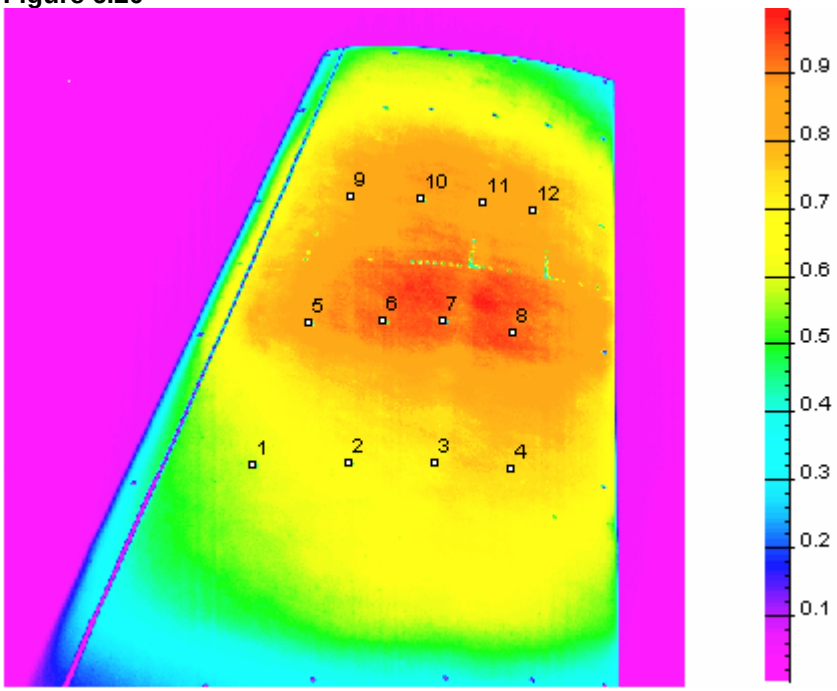
27. Open an existing file with coordinates of the markers STEP_6.MRK that is located in the same folder. Choose the **Open Markers...** command from the **Markers** menu. The standard ***Open Dialog*** will appear on your screen.

Figure 6.19



28. Choose the file STEP_6.MRK, and click the **Open** control button. The ***Open Dialog*** will be closed, and the markers on the bitmap will appear on your screen.

Figure 6.20



29. To add new markers:

- Choose the **Mark...** command from the **Markers** menu,

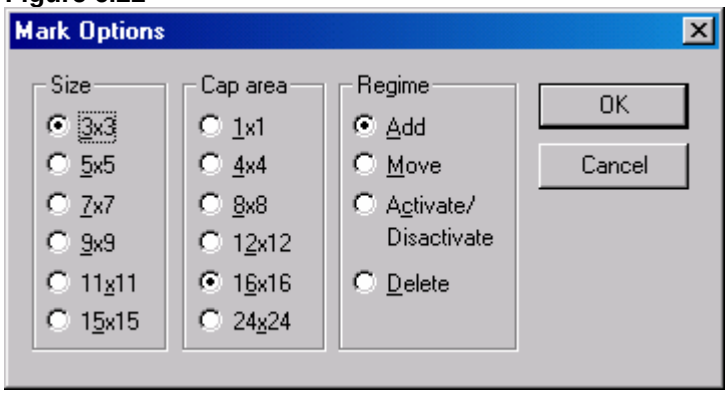
  or

- Click the following icon from the upper toolbar:

Figure 6.21

The ***Mark Options Dialog*** will appear on your screen.

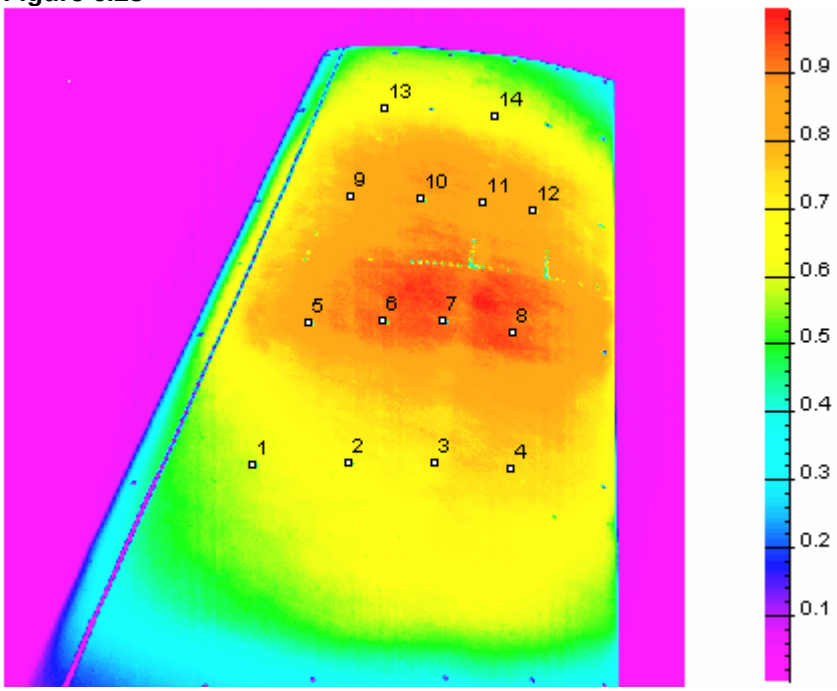
Figure 6.22



30. Choose all of the needed parameters in the ***Mark Options Dialog*** as shown above.

31. Click the **OK** control button. The cursor shape is changed to  . Click at the points on the bitmap, and the markers will be placed at these points.

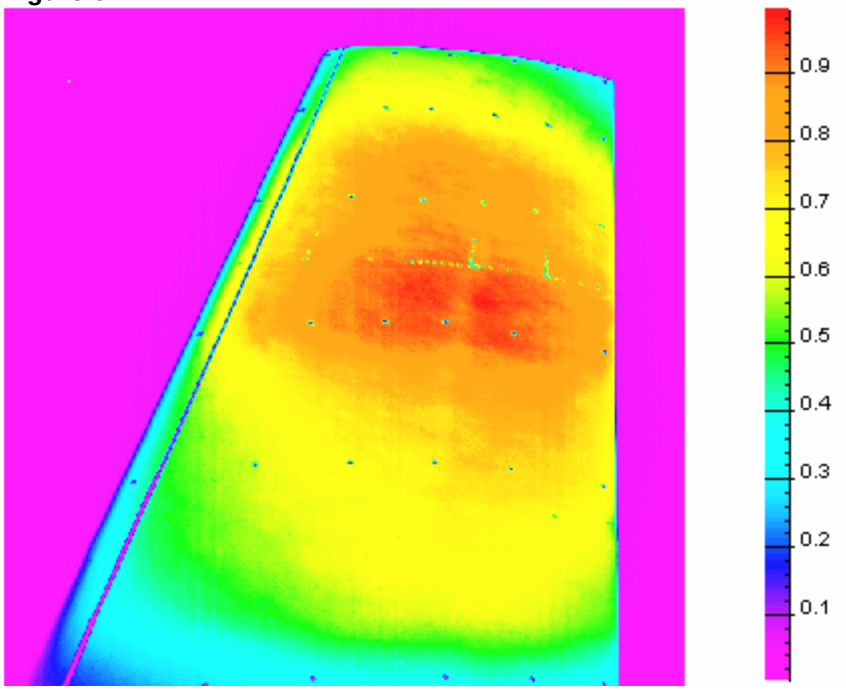
Figure 6.23



32. To turn off the regime of markers selected, choose the **Mark...** command from the **Markers** menu again.

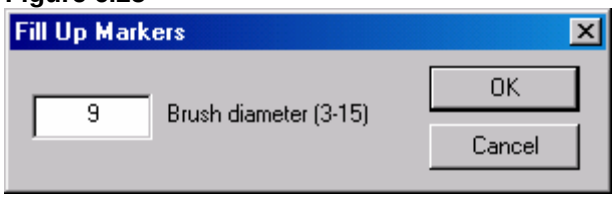
33. To hide the images of the markers on the bitmap, choose the **Hide Markers** command from the **Markers** menu.

Figure 6.24



34. To remove the dark spots of the marker images from the bitmap, choose the **Fill Up Markers...** command from the **Edit** menu. The ***Fill Up Markers Dialog*** will appear on your screen.

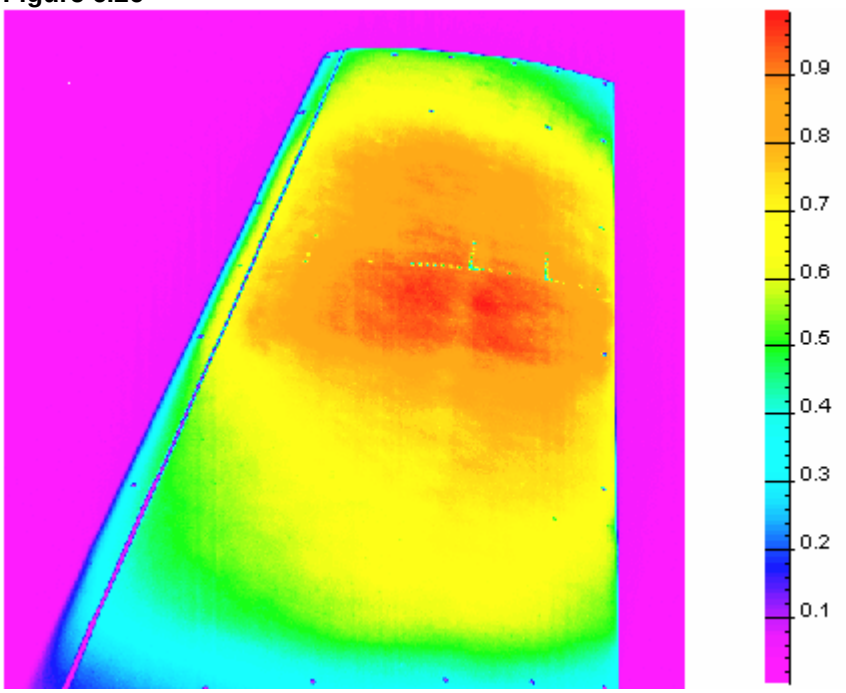
Figure 6.25



35. Choose all of the needed parameters in the ***Fill Up Markers Dialog*** as shown above.

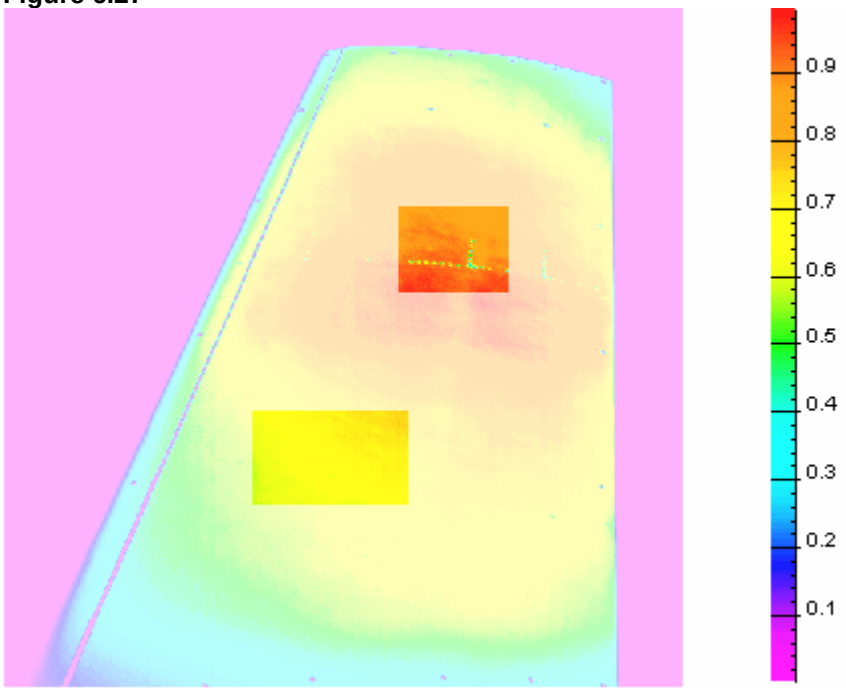
36. Click the **OK** control button. The regions of the markers will be bi-interpolated using region boundary points on the bitmap. (The region of the marker is the circle with the center at the point where the marker has been placed.)

Figure 6.26



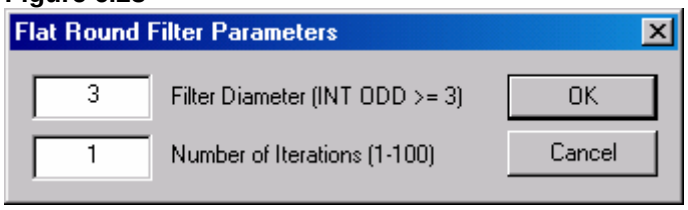
37. Create mask regions on the bitmap (for additional information see Steps 6-7).

Figure 6.27



38. Choose the **Flat Filter...** command from the **Edit** menu. The ***Flat Round Filter Dialog*** will appear on your screen.

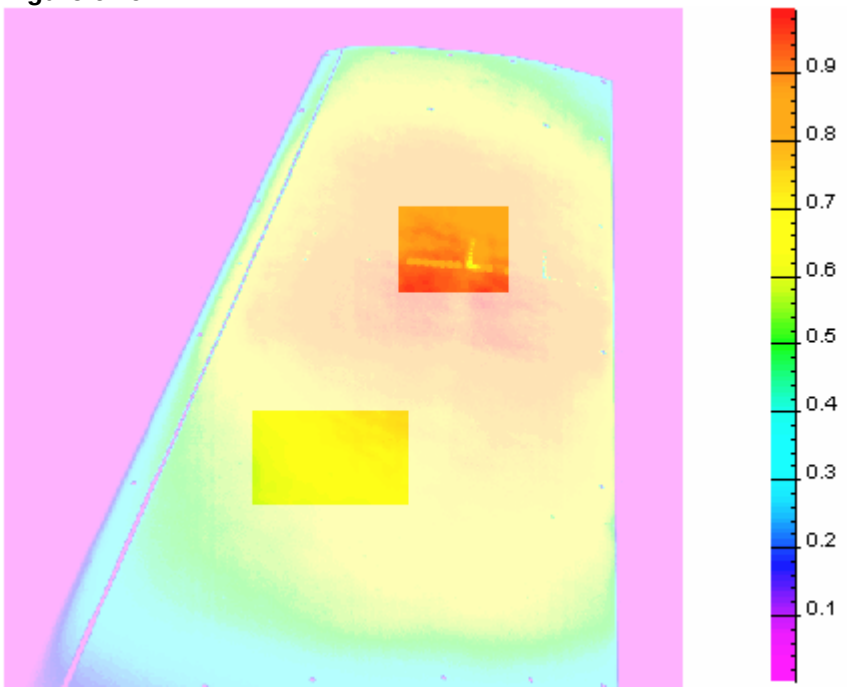
Figure 6.28



39. Choose all of the needed parameters in the ***Flat Round Filter Dialog*** as shown above.

40. Click the **OK** control button. The intensity in the masked regions will be changed using the flat filter.

Figure 6.29

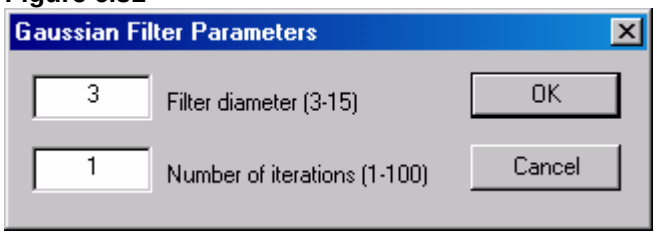


41. Choose the **Close** command from the **File** menu to close the bitmap.

42. Open an existing file STEP_6.P again (for additional information see Steps 1-2). **Figure 6.3** will appear on your screen.

43. Choose the **Gauss Filter...** command from the **Edit** menu. The ***Gaussian Filter Dialog*** will appear on your screen.

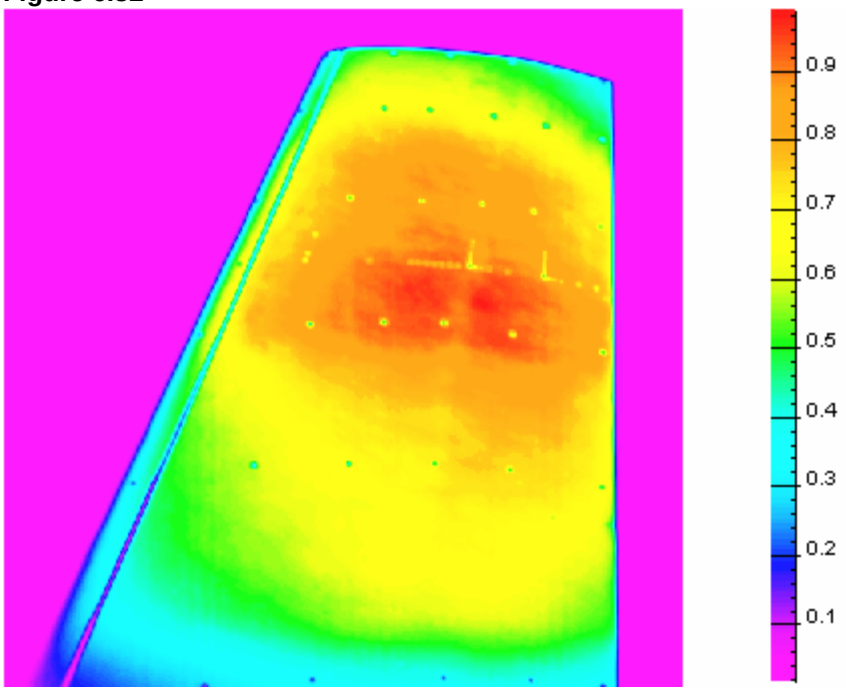
Figure 6.31



44. Choose all of the needed parameters in the ***Gaussian Filter Dialog*** as shown above.

45. Click the **OK** control button. The intensity on the bitmap will be changed using the Gauss filter.

Figure 6.32

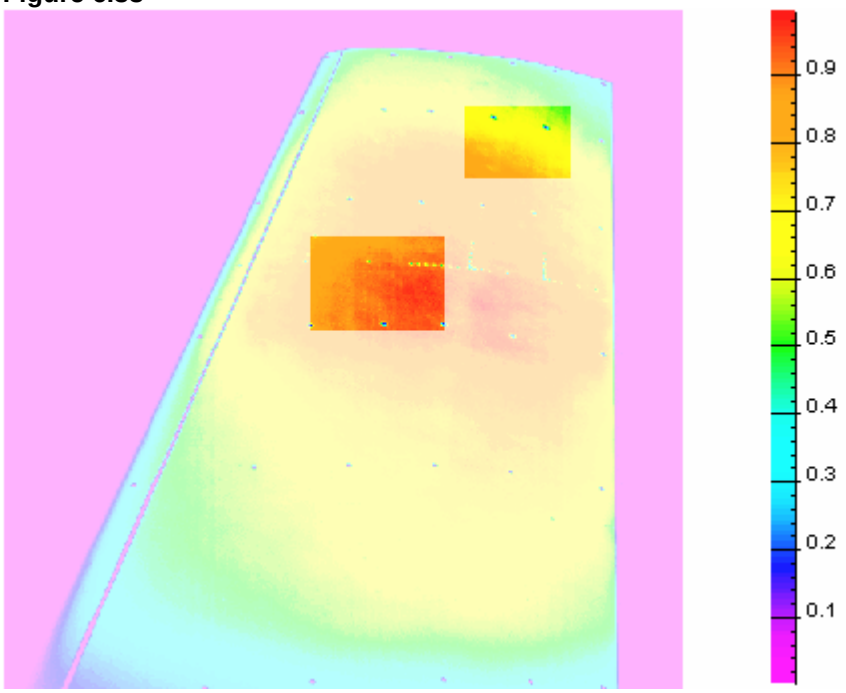


46. Choose the **Close** command from the **File** menu to close the bitmap.

47. Open an existing file STEP_6.P again (for additional information see Steps 1-2). **Figure 6.3** will appear on your screen.

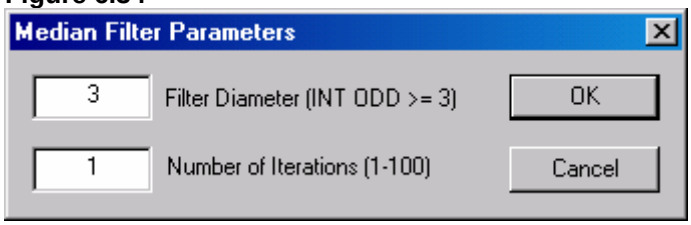
48. Create mask regions on the bitmap (for additional information see Steps 6-7.)

Figure 6.33



49. Choose the **Median Filter...** command from the **Edit** menu. The ***Median Filter Dialog*** will appear on your screen.

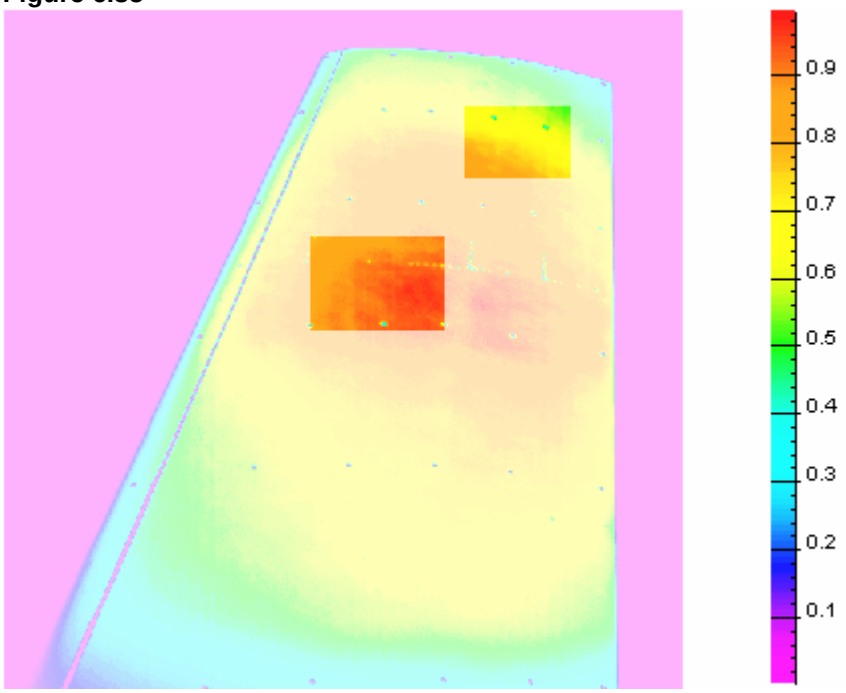
Figure 6.34



50. Choose all of the needed parameters in the ***Median Filter Dialog*** as shown above.

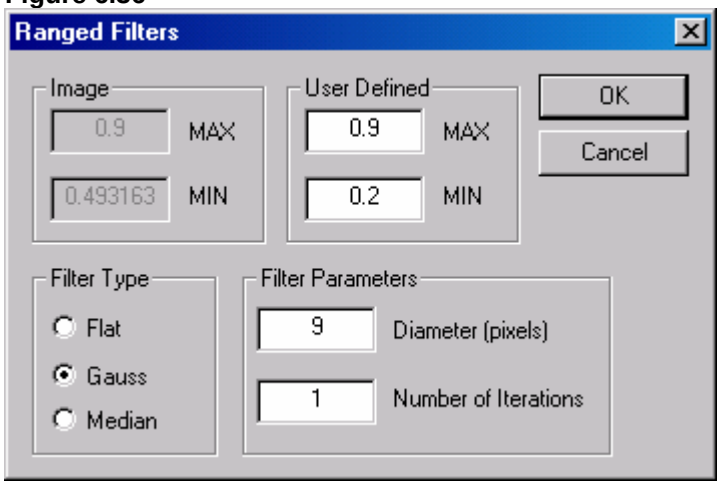
51. Click the **OK** control button. The intensity in the masked regions will be changed using the median filter.

Figure 6.35



52. Choose the **Ranged Filter...** command from the **Edit** menu. The ***Ranged Filter Dialog*** will appear on your screen.

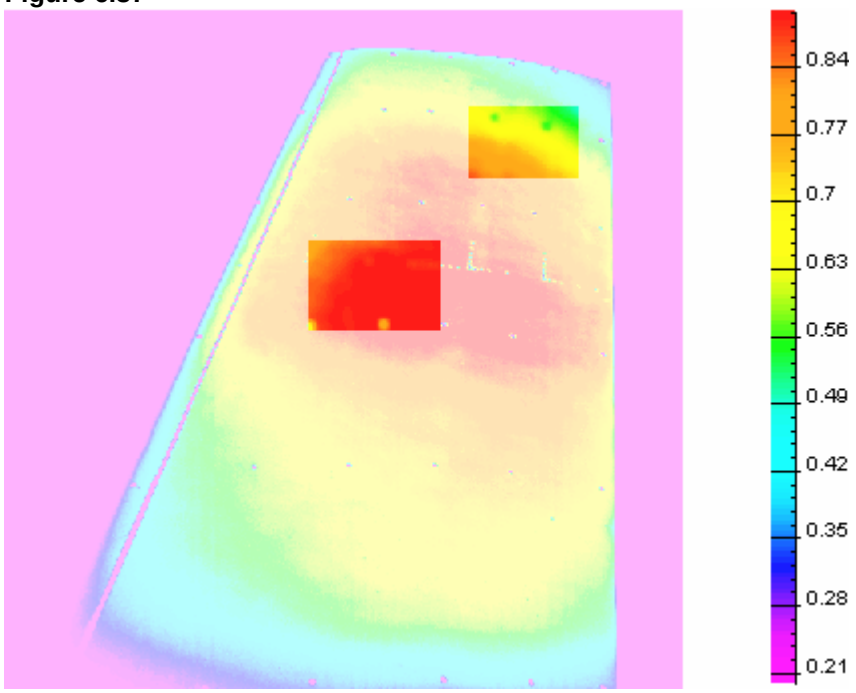
Figure 6.36



53. Choose all of the needed parameters in the ***Ranged Filter Dialog*** as shown above.

54. Click the **OK** control button. The intensity in the masked regions will be filtrated.

Figure 6.37



55. To undo the mask selection:

Choose the **Mask All** command from the **Mask** menu,

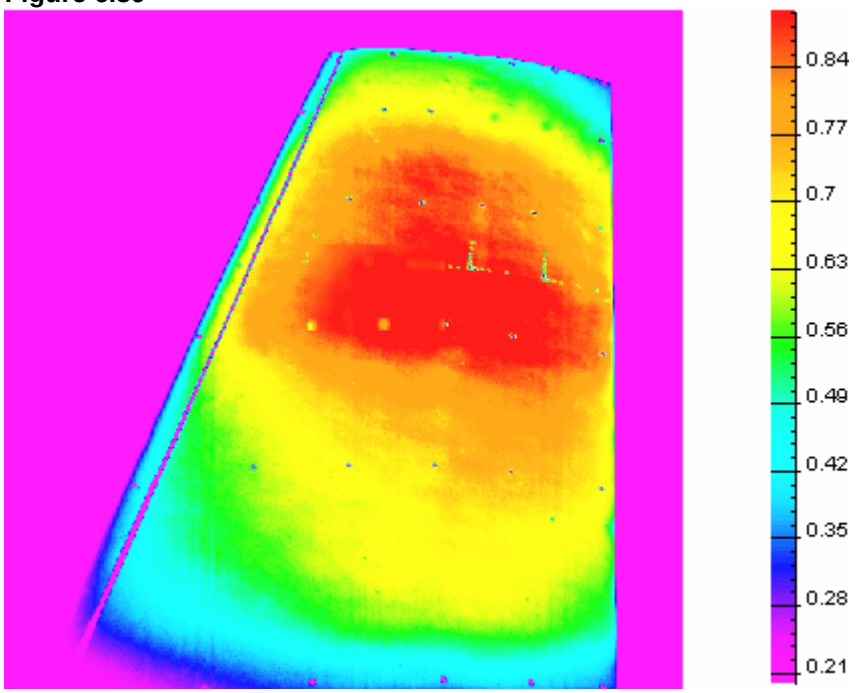
or

Click the following icon from the upper toolbar:

Figure 6.38

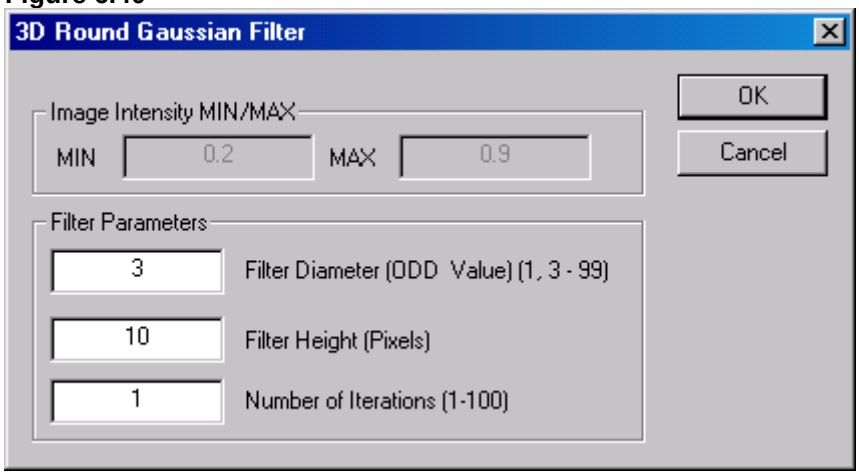
The entire bitmap will be represented with bright colors.

Figure 6.39



56. Choose the **3D Filter...** command from the **Edit** menu. The ***3D Round Gaussian Filter Dialog*** will appear on your screen.

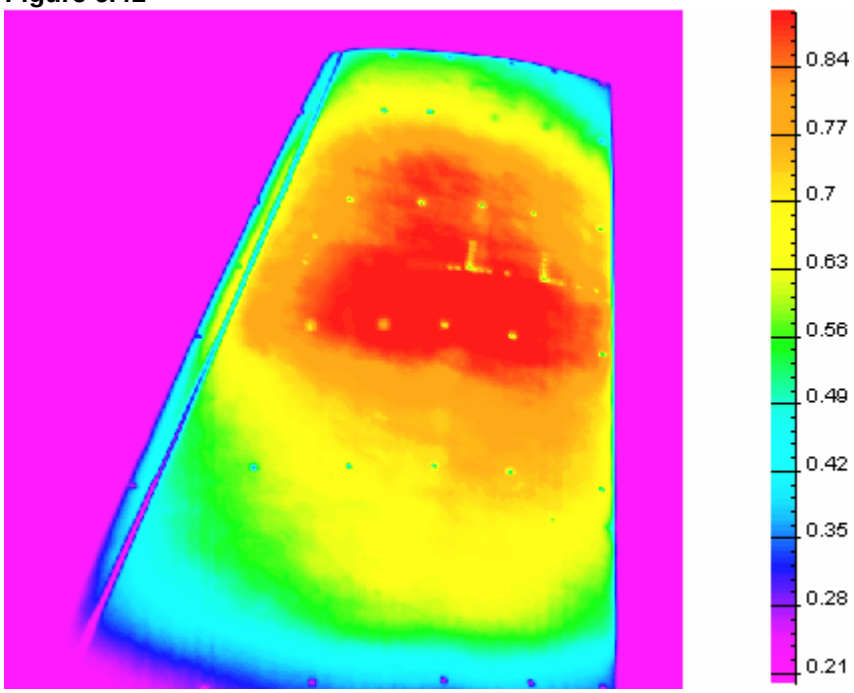
Figure 6.40



57. Choose all of the needed parameters in the ***3D Round Gaussian Filter Dialog*** as shown above.

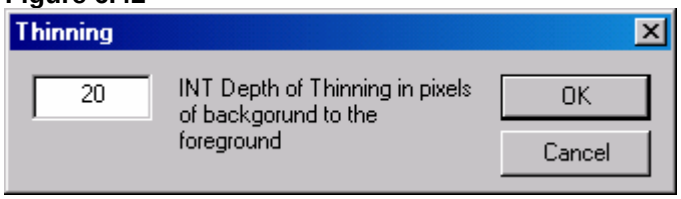
58. Click the **OK** control button. The intensity in the masked regions will be filtrated.

Figure 6.41



59. Choose the **Thinning...** command from the **Edit** menu. The ***Thinning Dialog*** will appear on your screen.

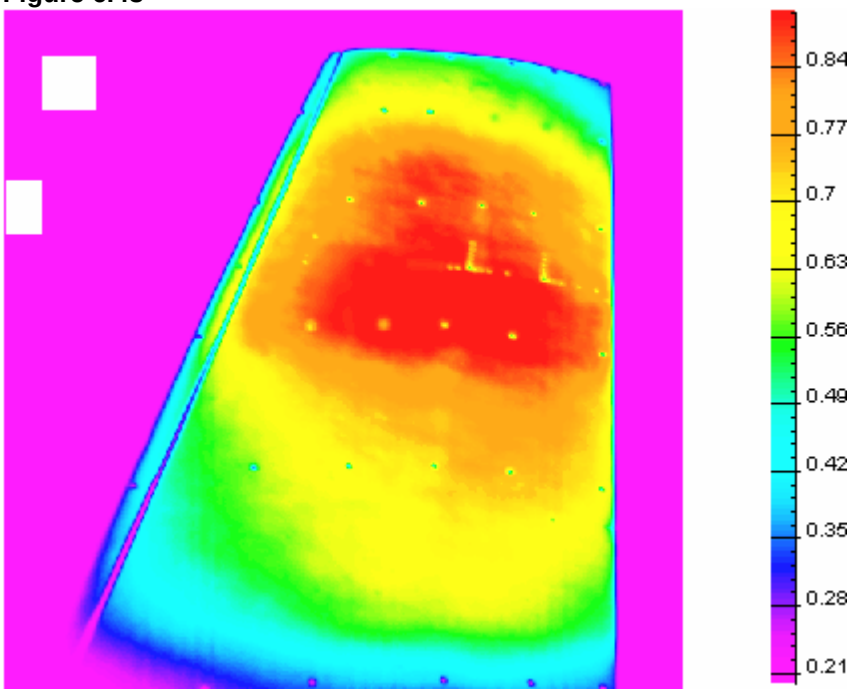
Figure 6.42



60. Choose all of the needed parameters in the ***Thinning Dialog*** as shown above.

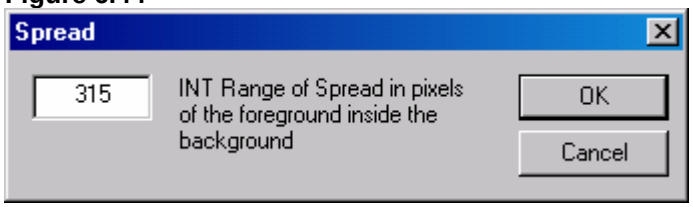
61. Click the **OK** control button.

Figure 6.43



62. Choose the **Expansion...** command from the **Edit** menu. The ***Spread Dialog*** will appear on your screen.

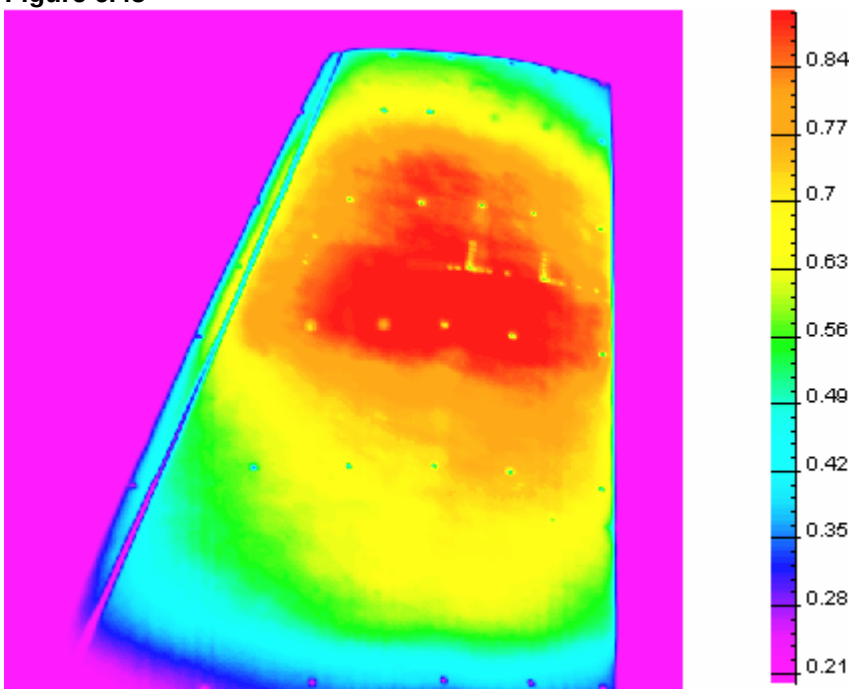
Figure 6.44



63. Choose all of the needed parameters in the ***Spread Dialog*** as shown above.

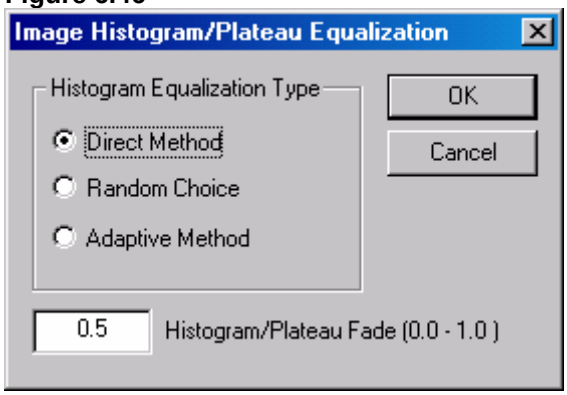
64. Click the **OK** control button.

Figure 6.45



65. Choose the **Weighted Hybrid Map...** command from the **Edit** menu. The ***Image Histogram Dialog*** will appear on your screen.

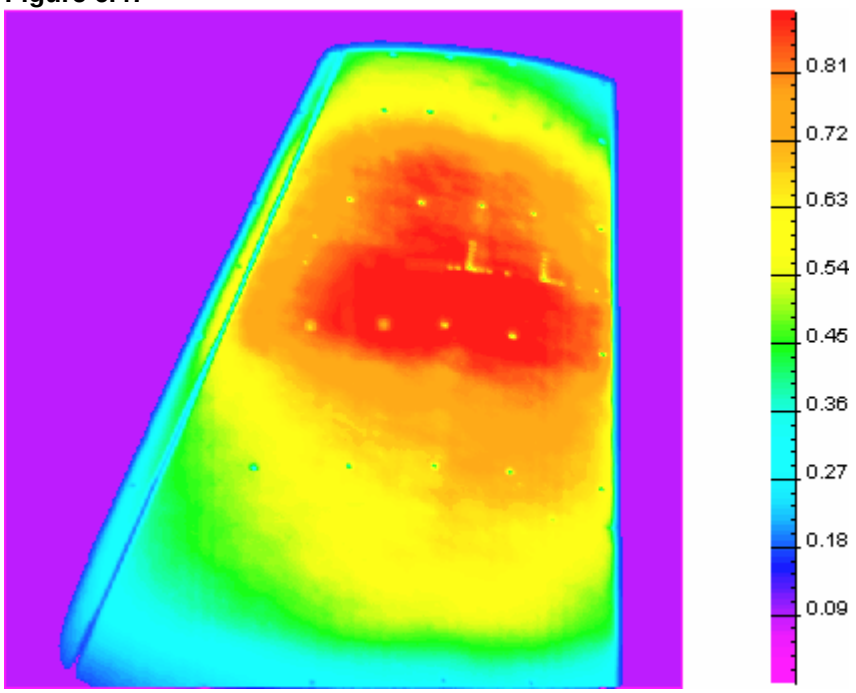
Figure 6.46



66. Choose all of the needed parameters in the ***Image Histogram Dialog*** as shown above.

67. Click the **OK** control button.

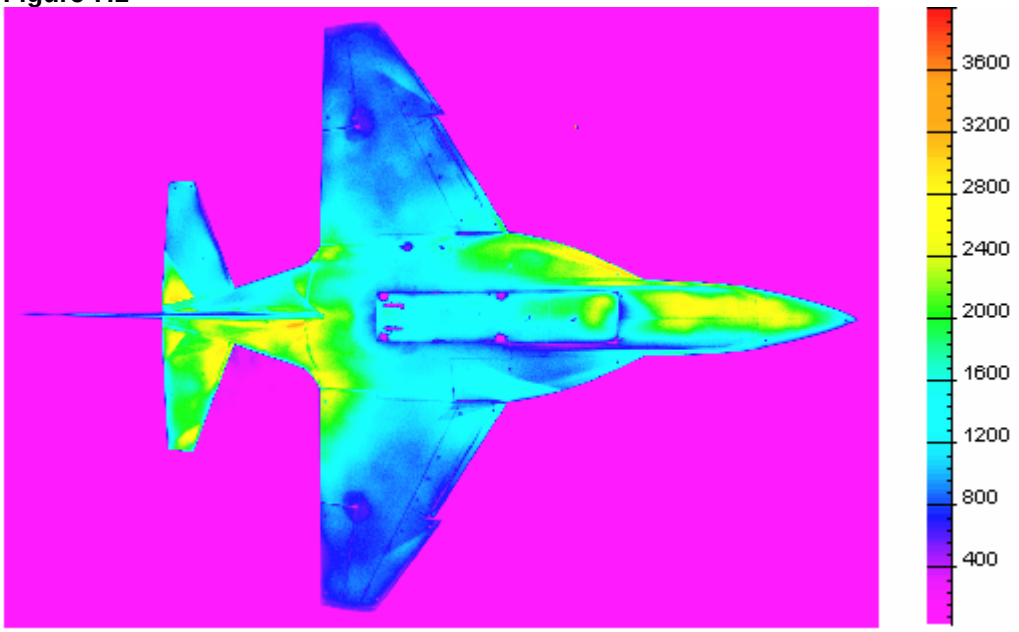
Figure 6.47



Step 7. Removing Background from a Bitmap

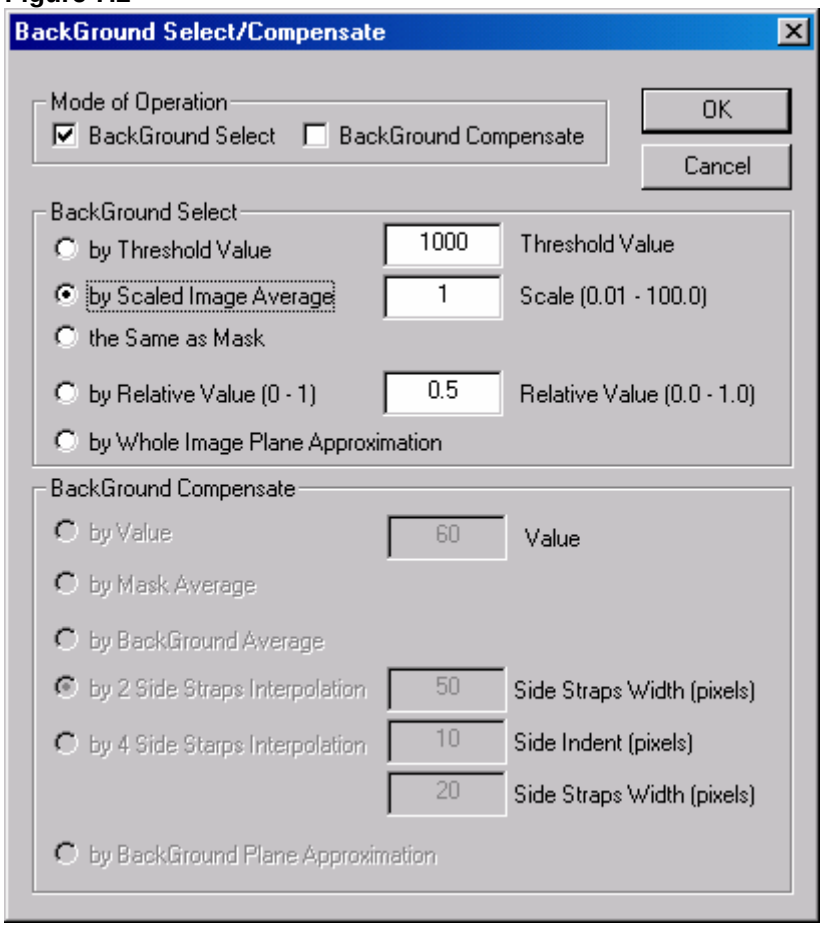
1. After running *ProImage*, open an existing bitmap STEP_7.B16 that is located in the subfolder SAMPLES\STEP_7 of the current folder (for additional information see Steps 1-2 of **Step 6**).

Figure 7.1



2. Choose the **BackGround...** command from the **Tools** menu to remove the background on the bitmap. The ***BackGround Select/Compensate Dialog*** will appear on your screen.

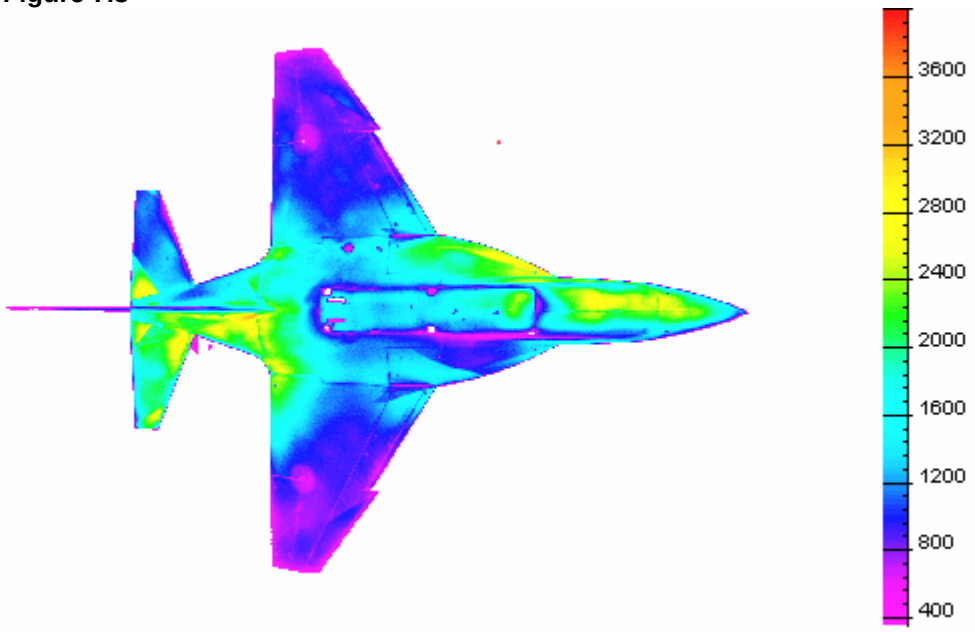
Figure 7.2



3. Choose all of the needed parameters in the ***BackGround Select/Compensate Dialog*** as shown above.

4. Click the **OK** control button. All of the intensities on the bitmaps that are less than the average intensity will be background.

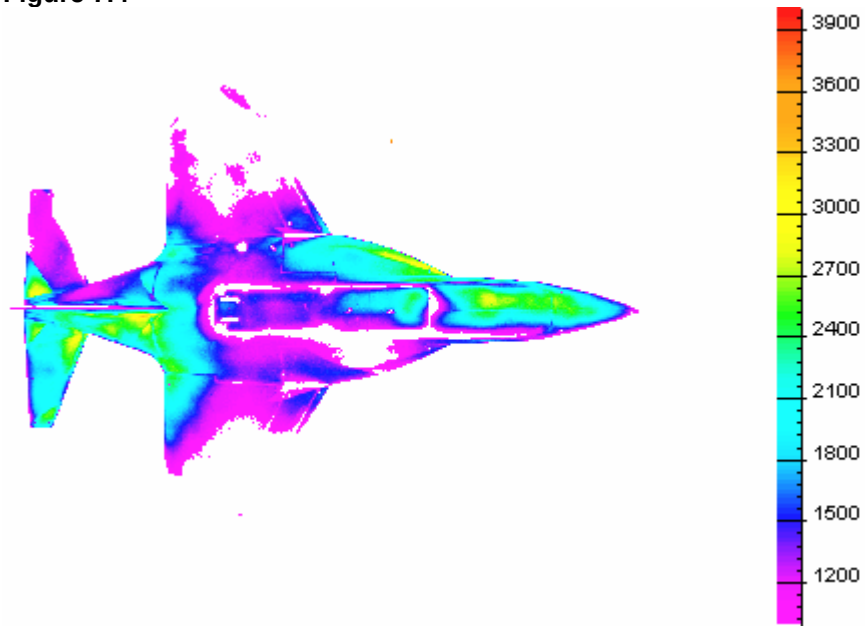
Figure 7.3



5. Choose the **BackGround...** command from the **Tools** menu. The ***BackGround Select/Compensate Dialog*** will appear on your screen again.

6. Turn on the **by Threshold Value** radio button, and type "1000" in the **Threshold Value** text box in the **BackGround Select** pane. Click the **OK** control button. All of the intensities on the bitmap that are less than 1000 will become background.

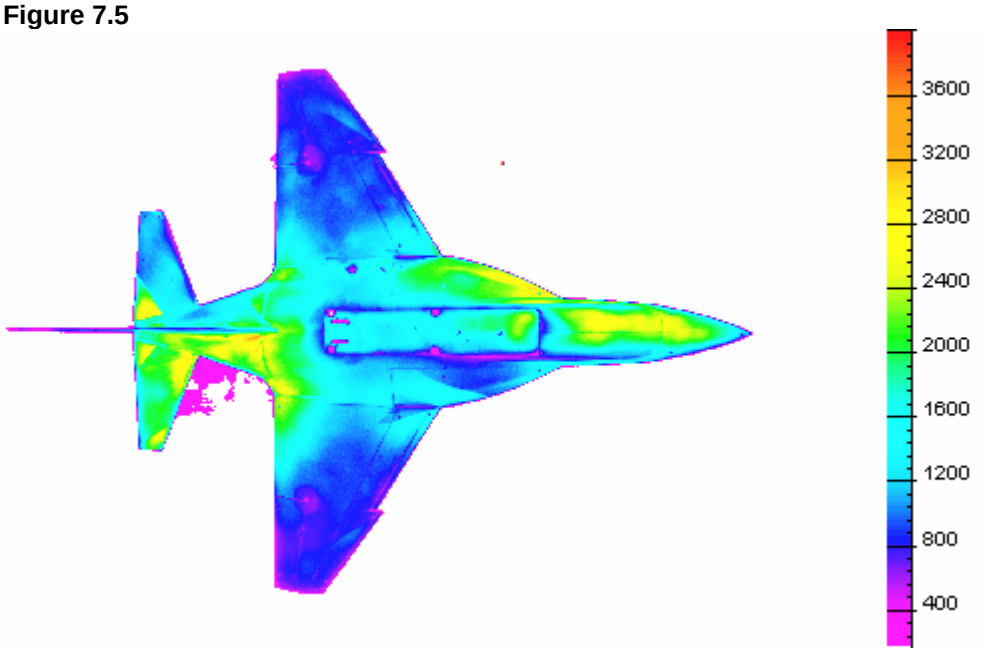
Figure 7.4



7. Choose the **BackGround...** command from the **Tools** menu. The ***BackGround Select/Compensate Dialog*** will appear on your screen again.

8. Turn on the **by Scaled Image Average** radio button, and type "0.5" in the **Scale** text box in the **BackGround Select** pane. Click the **OK** control button. All of the intensities on the bitmap that are less than one-half of the average intensity will be background.

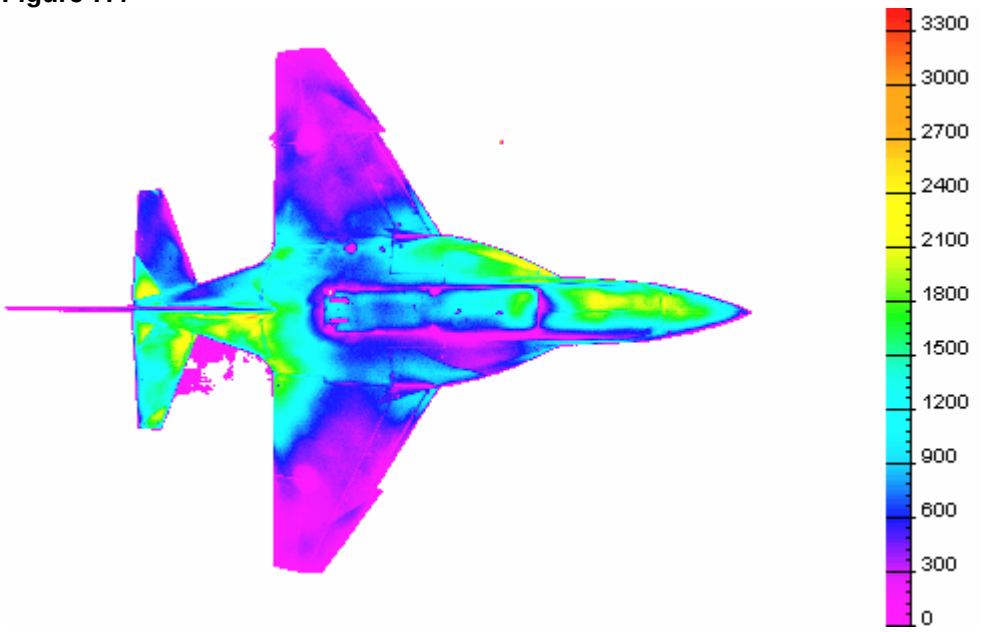
Figure 7.5



9. Choose the **BackGround...** command from the **Tools** menu. The ***BackGround Select/Compensate Dialog*** will appear on your screen again.

10. Turn off the **BackGround Select** check box, and turn on the **BackGround Compensate** check box in the **Mode of Operation** pane. Turn on the **by Value** radio button, and type "300" in the **Value** text box. Click the **OK** control button. The palette in the right-hand portion of the application window will be changed, and all of the intensities on the bitmap will be diminished by 300.

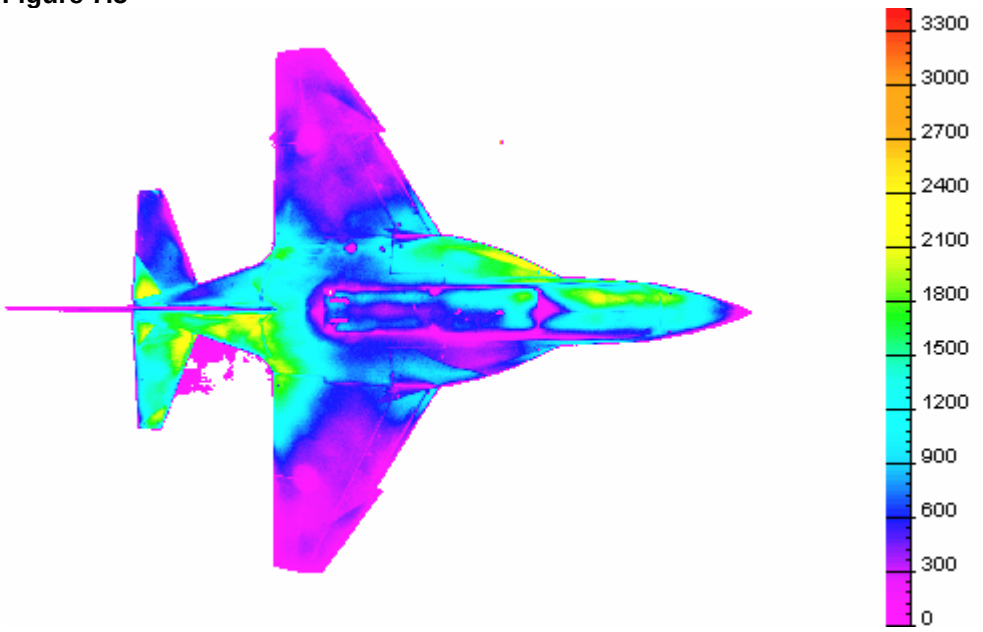
Figure 7.4



11. Choose the **BackGround...** command from the **Tools** menu. The ***BackGround Select/Compensate Dialog*** will appear on your screen again.

12. Turn on the **by 2 Sides Strap Interpolation** radio button, and type "100" in the **Side Straps Width** text box in the **BackGround Compensate** pane. Click the **OK** control button. The bitmap will be corrected.

Figure 7.5



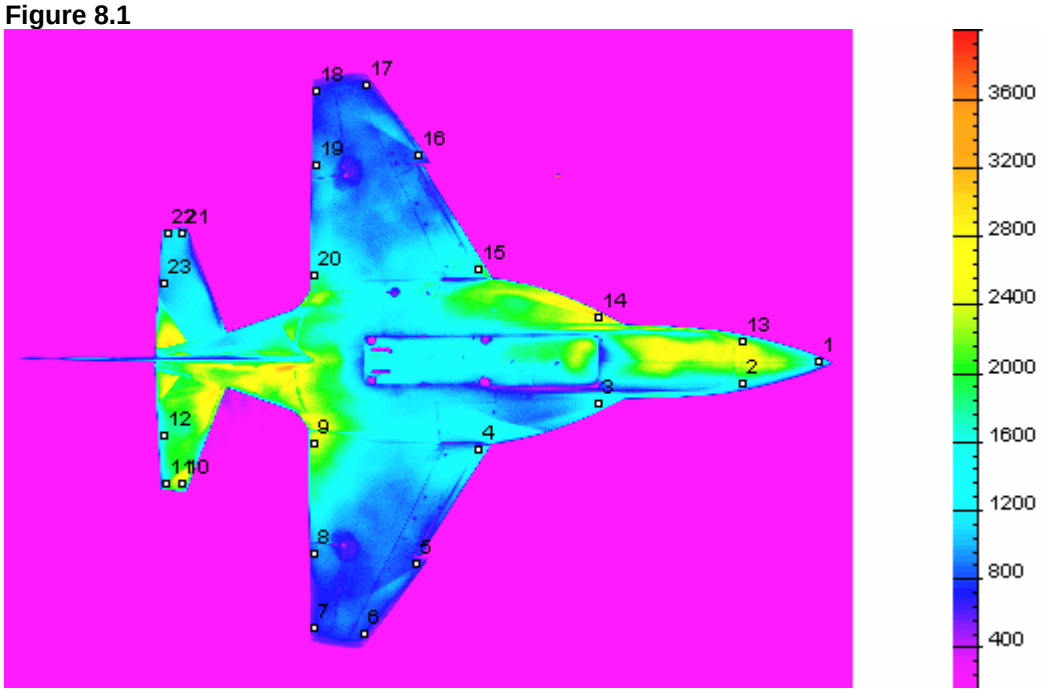
Chapter 4. Preparing Project File for *ProField* Application

Step 8. Preparing a File for *ProField* Application

The subfolder SAMPLES\STEP_8 of the current folder contains all of the files necessary to process the project (for additional information see Step 2).

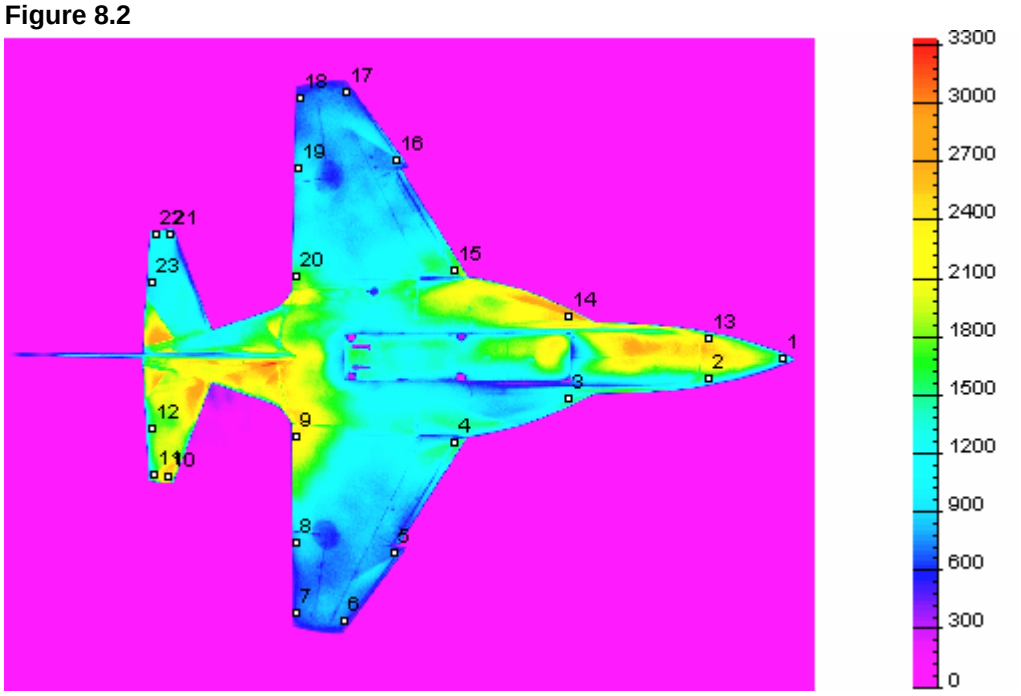
1. Open an existing file STEP_8.IMS that is located in the subfolder SAMPLES\STEP_8 of the current folder (for additional information see Steps 1-2 of **Step 2**). The wind-on sensitive bitmap will appear on your screen.

Figure 8.1



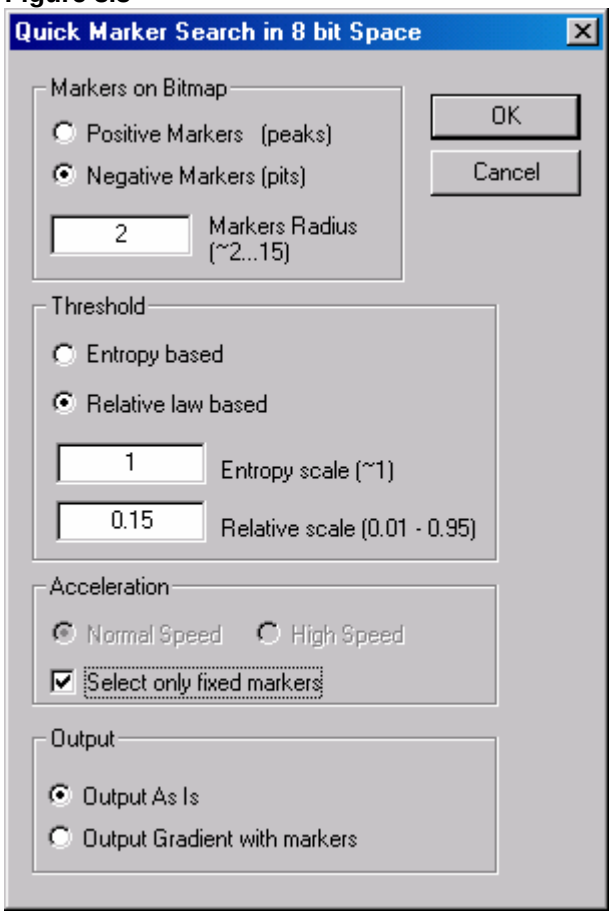
2. Repeat Steps 3-4 of **Step 2** with the same parameters.

Figure 8.2



3. Choose the **Automatic Marking...** command from the **B Convert** menu. The ***Quick Marker Search Dialog*** will appear on your screen.

Figure 8.3

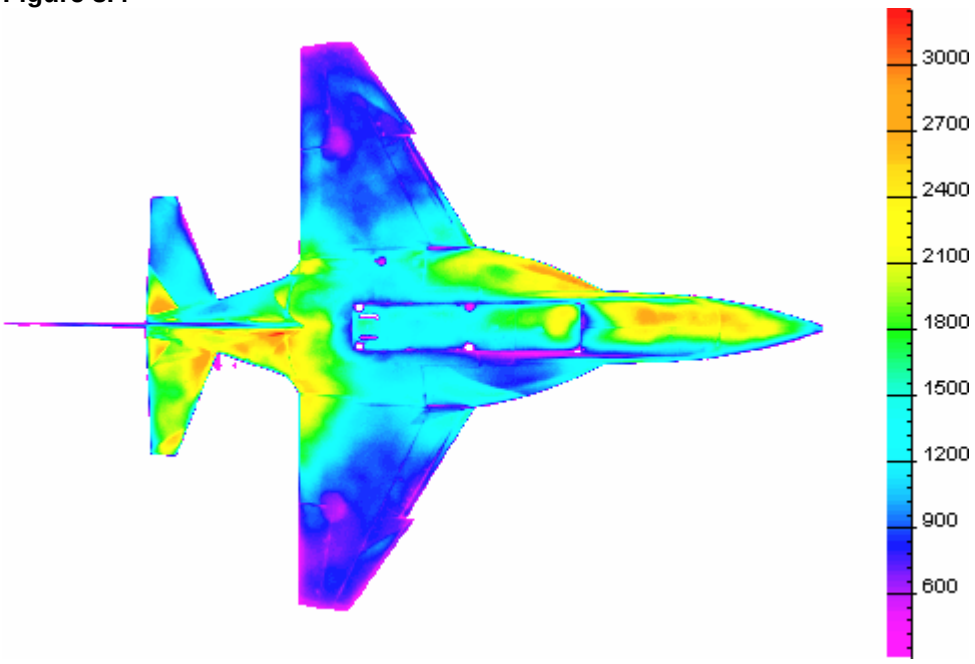


4. Choose all of the needed parameters in the ***Quick Marker Search Dialog*** as shown above.

5. Click the **OK** control button. Four bitmaps with markers will be created (wind-off reference, wind-on reference, wind-off sensitive, and wind-on sensitive). Use the **Image** command from the **View** menu to switch between these bitmaps.

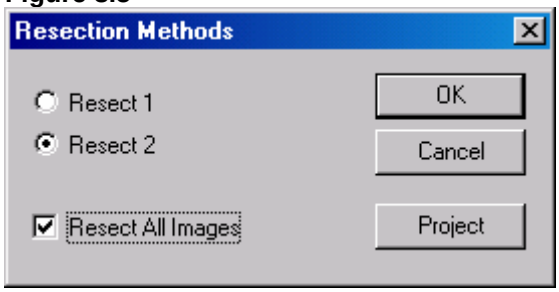
6. Repeat Steps 8-21 of **Step 2** with the same parameters.

Figure 8.4



7. To restore the 3D Flowfields from all of the project bitmaps, choose the **Resection...** command from the **OMS Field** menu. The ***Resection Methods Dialog*** will appear on your screen.

Figure 8.5



8. Choose all of the needed parameters in the ***Resection Methods Dialog*** as shown above.

   Note. It is recommended that the **Resect 1** be used when 3D markers are measured with mean accuracy. In this case the **Resect 1** yields a reliable solution. It is recommended that the **Resect 2** be used when the 3D markers are measured with extremely high accuracy. Although the **Resect 2** yields a more exact solution than **Resect 1**, the solution is not so reliable.

9. Click the **OK** control button. Warning messages about the transformation error will appear on the screen.

10. Click the **OK** control button, or press Enter. STEP_8.XYZ will be created. It contains 3D flowfields that are mapped from the wind-off reference, wind-off sensitive, wind-on reference, and wind-on sensitive bitmaps. The bitmaps with markers are also mapped on the 3D mesh to create appropriate 3D Flowfields.

11. Choose the **Close Project** command from the **B Convert** menu to close the project file.